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THE KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY.

EDITED BY

THEO. S. CASE.

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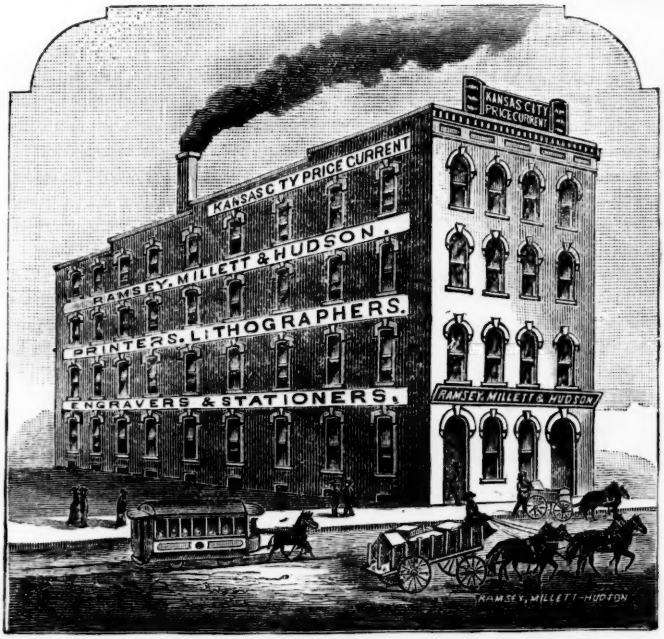

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VOL. VI. SEPTEMBER, 1882. NO. 5

ANTHROPOLOGY.

WHO WERE THE MOUND-BUILDERS?

F. F. HILDER.

The March number of the Kansas City REVIEW contains an article by Dr. J. F. Snyder, under the above head, which commences with the following paragraph:

"The conviction is daily gaining strength that the race of Indians found in occupancy of this country when it was discovered by Europeans were the people, or the immediate descendants of the people, who built the mounds; and students of American Archæology now agree that mound-building was practiced by some of the tribes down to a comparatively recent date."

This statement is very indefinite, so much so, that as a student of archæology I cannot accept it without considerable qualification. The ancient people or tribes who for want of a better name have been styled the mound-builders, have left traces of their occupation on a vast expanse of territory, extending from Lake Superior to the Gulf of Mexico, and from the Alleghany Mountains to the country west of the Mississippi. Webster gives the definition of the word

Race, "A family, tribe, people, or nation believed or presumed to belong to the same stock."

And in a foot note says, "The American or red race containing the Indians of North and South America." This all-embracing definition is probably the

sense in which Dr. Snyder uses the word. If so, he will doubtless find few archæologists to differ with him.

Whatever may have been the origin of the mound-building people, there is very little doubt that they were distinctively American in form and feature. Although the color of the skin varies considerably, as must be the case on a continent extending through one hundred and twenty degrees of latitude, physical peculiarities exist from which it may be inferred that all the peoples of America belong to a single race bearing some resemblance to the Mongolian nations of the Old World; but that race is and has been divided into so many nations and tribes, exhibiting such striking contrasts and wide disparities, that the term race as applied to the successive occupants of any particular territory becomes altogether too vague to be of any special significance. Prof. J. W. Powell says*: "When America was discovered by Europeans it was inhabited by great numbers of distinct tribes, diverse in languages, institutions and customs. This fact has never been fully recognized, and writers have too often spoken of the North American Indians as a body, supposing that statements made of one tribe would apply to all. This fundamental error in the treatment of the subject has led to great confusion."

So far as the term "race" is used in its widest sense I agree with Dr. Snyder, but I contend that the ancient people who built the gigantic mounds and earthworks of the Mississippi Valley, and who left behind them so many evidences of their skill and taste, although they too were probably divided into several tribes, were a very different people from the barbarous hunters and warriors who lived on the shores of Lake Superior or who ranged through the forests and prairies of that part of the continent which we now call Ohio, Illinois, Indiana, Iowa, and Missouri, when first visited by European explorers. Dr. Snyder must, to some extent at least believe this to be the case as he uses as illustrations of the condition of the Indian tribes at that date, the Mandans, Choctaws, and Natchez, all of which, but more particularly the two last named, were far in advance of the barbarous tribes by whom they were surrounded and who are supposed by most ethnologists to represent descendants of remnants of the mound-building nations. Therefore, if Dr. Snyder means that the nomadic hunting tribes who occupied the territory above named when discovered by Europeans were the direct or immediate descendants of the people who built the great mounds I certainly differ with him. It is true, as he states, that mere opinions in matters of science are not sufficient to influence the convictions of thinking men, but the conclusions of careful students are always acceptable as exemplifying the effect produced on different minds by the same evidence; however much we may at times differ from them they are always entitled to respect as honest expressions of opinion. I have therefore selected the following extracts from the published writings of some of the gentlemen who are named by Dr. Snyder as supporting his views:

Squier and Davis say,[1] "The earthworks and the mounds and their con-

* First Annual Report Bureau of Ethnology, page 74.

1 Ancient Monuments of the Mississippi Valley, page 273.

tents certainly indicate that, prior to the occupation of the Mississippi Valley by the more recent tribes of Indians there existed here a numerous population, agricultural in their habits, considerably advanced in the arts, and undoubtedly in all respects much superior to their successors."

Also,[2] "We may venture to assert that the facts thus far collected point to a connection more or less intimate between the races of the mounds and the semi-civilized nations which formerly had their seats among the Sierras of Mexico and upon the plains of Central America and Peru."

Lewis H. Morgan says[3]: "The mound-builders had disappeared at the epoch of the European discovery and cannot be classed with any known Indian stock."

Also,[4] "From the absence of traditionary knowledge of the mound-builders among the tribes found east of the Mississippi an inference arises that the period of their occupation was ancient. Their withdrawal was probably gradual, and completed before the advent of the ancestors of the present tribes or simultaneous with their arrival."

Dr. Joseph Jones says,[5] "The most important inference appears to be that the mound-builders and stone grave races of the Mississippi Valley had a common origin or near affinity with the aboriginal inhabitants of Mexico and Central America.

Also,[6] "It is impossible to assign the monumental remains of Tennessee to any specific date or to any known nation of North American Indians."

C. C. Jones, Jr., says,[7] in speakingof mounds in Georgia: "The location and physical peculiarities of some tumuli and enclosures, the character of the remains found in and near them, the presence of stone idols and metallic ornaments and the traditions of modern Indians, who regard them with commingled ignorance and wonder, unite in claiming for them not only a marked antiquity, but also, a striking resemblance to the monuments of the Mississippi Valley."

Also,[8] in speaking of a great mound on the Etowah River: "To the eye of the observer as it rests for the first time upon its towering form, it seems a monument of the past ages, venerable in its antiquity, solemn, silent, and yet not voiceless, a remarkable exhibition of the power and industry of a former race. With its erection the modern hunter tribes, so far as our information extends, had naught to do."

Also,[9] "The fact has been distinctly attested by early travellers that the Indians of this region never worshiped idols. We have further testimony that they not only never manufactured these symbols of pagan worship, but emphatically disclaimed all knowledge of the people by whom they were made. Who,

2 Ancient Monuments of the Mississippi Valley, page 301.
3 Houses and House Life of the American Aborigines, page 193.
4 Houses and House Life of the American Aborigines, page 219.
5 Explorations of the Aboriginal Remains of Tennessee, page 78.
6 Explorations of the Aboriginal Remains of Tennessee, page 157.
7 Antiquities of the Southern Indians, page 134.
8 Antiquities of the Southern Indians, 137.
9 Antiquities of the Southern Indians, 146.

then, were these mound-builders, and who the artificers that chiselled these rude stone images, which did not fall down from Jupiter?

I think after a careful perusal of the above quotations it will be admitted that the writers do not arrive at exactly the same conclusions as Dr. Snyder respecting the connection between the mound-builders and the modern tribes of Indians.

With respect to the building of burial mounds by the modern Indians, there is no disputing the fact that it has been practiced by some of the tribes down to a comparatively recent date, and I do not know that any archæologist of repute has ever doubted or denied it.

E. G. Squier says,[0] "It is certain that the existing tribes of Indians often buried in the ancient tumuli, and occasionally erected mounds."

I do not think Dr. Snyder arrives at correct conclusions respecting Mr. Squier's report on the Aboriginal Monuments of New York, in the second volume of "Contributions to Knowledge," of the Smithsonian Institution. Dr. Snyder says: "Mr. Squier describes mounds and earthworks extending from Canada to the Susquehanna which were found to contain ornamental pottery, pipes, stone axes, hammers and discs, and other stone-age implements, identical in shape and materials with similar specimens found by him in the Ohio mounds, and bone-awls and needles, together with iron axes, glass beads, cast copper hatchets, kettles of iron, brass, and copper, and other articles of European manufacture."

I find that Mr. Squier selects only four examples out of all the collection he made from the above mounds as resembling those found in Ohio and these are such that they might have been common to any people who used stone implements.

Further on Dr. Snyder says, "The building of these mounds he was forced to assign to the Iroquois within comparatively recent dates; though in every essential particular they were exactly like the older mounds in central Ohio."

For the sake of comparison I will quote a few paragraphs from the work in question.

Mr. Squier says,[1] "We have no satisfactory evidence that the race of the mounds passed over the Alleghanies, the existence therefore of a few tumuli to the east of these mountains, unless in connection with other and extensive works such as seem to have marked every step of the progress of that race, is of little importance, as it will hardly be denied that the existing races of Indians did and do still occasionally construct mounds of small size."

Also,[2] "The ancient remains of western New York except so far as they throw light upon the system of defence practiced by the aboriginal inhabitants and tend to show that they were to a degree fixed and agricultural in their habits,

0 American Archæological Researches, page 135.
1 Aboriginal Monuments of New York, page 107.
2 Aboriginal Monuments of New York, page 10.

have slight bearing upon the grand ethnological and archæological questions involved in the ante-Columbian history of this continent."

Also,[3] "Misled by statements which no opportunity was offered of verifying I have elsewhere though in a guarded manner, ventured the opinion that the ancient remains of western New York belonged to the same system with those of Ohio and the west generally."

I do not find in any of the above paragraphs evidence that Mr. Squier endeavors to convey the impression that he considered a similarity to exist between the ancient mounds of Ohio and the New York works, but on the contrary their tendency is toward an opposite conclusion.

Fully admitting that modern tribes of Indians erected burial mounds I can see no connection between the erection of a few insignificant tumuli such as that described by Catlin over the remains of the Omaha chief and his horse, and the building of a great truncated pyramid like that at Cahokia, covering acres of ground and containing, as has been estimated twenty millions of cubic feet of earth, or the construction of the wonderful series of earth-works in Ohio with their regular outlines, true circles and accurate squares. The one is just such a memorial as might be raised by the rudest tribe of savages in honor of a deceased chief; the others must have been the work of a people essentially different in their habits and existing in a widely dissimilar condition of society.

Dr. Snyder says, "The mounds of the Mississippi basin are in no essential particular different from those seen on the plains of Europe or the steppes of Asia."

The definition of the word mound is, "An artificial hill or elevation of the earth," consequently in such simple structures there can be no essential difference wherever they may exist, but the term is a misnomer when applied to such structures as the great truncated pyramids of Cahokia and Seltzertown and many others of their class, with their graded avenues, terraces and regularity of form, to the so-called sacrificial mounds, or to the wonderful earth-works of Ohio; these structures are not only essentially different from the tumuli so profusely scattered over Europe and Asia, but they serve to distinguish the ancient people of the Mississippi Valley from all others on this continent.

Professor D. Wilson says, "The so-called sacrificial mounds are a class of ancient monuments altogether peculiar to the New World and highly illustrative of the rites and customs of the ancient races of the mounds."

It is unfortunate that the name mound-builders has been applied to these ancient people, as it is apt to create a false impression with respect to the distinctive character of their works, and to add to the confusion which exists in so many minds on all subjects appertaining to the aborigines of America.

I think that Dr. Snyder in his efforts to prove that the ancient people were mere barbarians, makes some assertions that are open to criticism; he says, "The builders of the mounds knew nothing of astronomy or mathematics," also "They lived in temporary huts of frail, perishable materials and had not advanced

3 Aboriginal Monuments of New York, page 11.

to the art of constructing stationary abodes of clay or stone." While we have no evidence either affirmative or negative respecting their knowledge of astronomy, I think there is strong presumptive proof that they had made considerable advance in the direction of mathematics. In speaking of the Ohio earth-works Squier and Davis say,[4] "There is one deduction to be drawn from the fact that the figures entering into these works are of uniform dimensions which is of considerable importance in its bearings upon the stock of knowledge among the people who erected them. It is that the builders possessed a standard of measurement and had some means of determining angles. The most skillful engineer of the day would find it difficult without the aid of instruments to lay down an accurate square of the great dimensions of those above represented measuring as they do more than four-fifths of a mile in circumference. We do not only find accurate squares and perfect circles, but also as we have seen, octagons of great dimensions."

These remarks apply to a series of works in Ross County, Ohio, which are in sets of one square and two circles, each side of every square measuring 1,080 feet and the diameter of each circle 1,780 feet, all of them accurate mathematical figures. It will be very difficult to explain how these works could have been erected unless the builders possessed some mathematical knowledge. Stoddard, in speaking of one of the Ohio works says,[5] "This work manifests a degree of mathematical skill not possessed by the aborigines and by few only of those deemed intelligent whites. To suppose it the invention of any other than a skillful mathematician requires a greater extent of credulity than is allowable among men of sense and reflection."

I think the characterizing their dwellings as "temporary huts of frail perishable materials" is an error, as there are still existing in many places in Missouri traces of towns and settlements where the vestiges of their habitations may be seen by hundreds, while in very many instances, without doubt, similar remains have been obliterated by modern agriculture. There are now no traces existing of ancient habitations in the neighborhood of the great Cahokia mound in Illinois, but Brackenridge who visited it in the year 1811 found them in abundance; he says,[6] "I everywhere observed a great number of small elevations of earth to the height of a few feet, at regular distances from each other and which appeared to observe some order; near them I also observed pieces of flint and fragments of earthen vessels. I concluded that a populous town had once existed here, similar to those of Mexico described by the first conquerors." Such traces certainly indicate that the dwellings were not temporary huts of frail, perishable materials, but they are exactly such remains as would exist, of houses built of adobe or sun-dried brick, after exposure to the rains and frosts of centuries in our variable climate; that they used such bricks I am in a position to prove, as in exploring an ancient town site in Scott County, Missouri, I exhumed a large quantity of frag-

4 Ancient Monuments, page 61.
5 Stoddard Sketches of Louisiana, page 347.
6 Brackenridge—Views of Louisiana, page 174.

ments of them, made of well-tempered clay, bearing impressions of the straw or wild hay with which they had been mixed.

I speaking of the great mound at Seltzertown, Dr. Dickeson, who is quoted by Squier and Davis,[7] alludes to the use of sun-dried bricks in its construction: "The north side of the mound is supported by a wall of sun-dried bricks, two feet thick, filled with grass, rushes and leaves. Angular tumuli mark the corners which were formed of large bricks retaining the impression of human hands."

Dr. Foster also alludes to the use of clay for building,[8] "Professor Swallow has observed the imprint of human hands in the clay which enters into some of the ancient structures in the region of New Madrid."

Dr. Snyder says that "there is no foundation for a belief that they lived under any form of political government or had any formulated mode of worship, or entertained religious sentiments more elevated than the grossest superstition;" and adds "This summary sketch accurately depicts the status of the mound-builders, and is a correct representation of the condition of the southern Indians when first discovered." From all that I have been able to glean by personal research and from writers on the subject, I think he has been too hasty in arriving at such conclusions respecting both the mound-builders and the southern Indians.

C. C. Jones, Jr., says,[9] "Among the Natchez the machinery of temples, idols, priests, keepers of sacred things, and sundry religious festivals was most elaborate. The preservation of the eternal fire engaged their utmost solicitude. The Sun (chief) ruled with despotic power and served in his person to unite the privileges of king and high-priest. There were observed more emphatically than among any other southern tribes, the distinctions of rank. The common people were to the last degree submissive to the nobility consisting of Suns, nobles and men of rank."

This is certainly an opposite condition to living "without any form of political government or formulated mode of worship," and this is one of the nations or tribes that Dr. Snyder himself puts on a level with the ancient mound-builders, and I think with some degree of reason, as I believe it quite possible that some of their descendants may have existed among these and other southern peoples.

Dr. Snyder concludes his article with a quotation from the "Ancient Copper Mines of Isle Royale," by Prof. N. H. Winchell. As that paper has been answered by Mr. J. P. Maclean in "The American Antiquarian," who says "It is remarkable for its erroneous statements and its misapprehension of facts;" I shall merely notice a few inaccuracies that have escaped Mr. Maclean's notice which afford additional evidence of its unreliability as an authority.

Prof. Winchell devotes more space to the question of the identity of the mound-builders, than to the ancient copper mines, and uses the same line of argument as Dr. Snyder relating to the building of mounds by modern Indians; making quotations from several authors to support his position, one of which reads as

7 Ancient Monuments, pages 117-118.
8 Pre-Historic Races, page 113.
9 Antiquities of Southern Indians, page 22.

follows, "Beck's Gazetteer" (page 308) states that "a mound of the largest dimensions has been thrown up, within a few years, in Illinois, over the remains of an eminent chief." When a writer gives the name of a book and the number of the page, and uses inverted commas, it is generally supposed that within those quotation marks he uses the exact language of his authority; how Prof. Winchell has followed this rule is best exemplified by giving the correct quotation, which reads thus: "Beck's Gazetteer," (page 308),—"One of the largest mounds in this country has been thrown up on this stream, within the last thirty or forty years, by the Osages, near the great Osage village, in honor of one of their deceased chiefs." The stream referred to by Beck is the Osage River, which is n Missouri, not in Illinois. Beck says it was erected thirty or forty years ago, and as his "Gazetteer" was published fifty-nine years ago, this would make the age of the mound nearly a century, instead of a few years. The quotation as made by Prof. Winchell is therefore totally at variance with the book quoted. Even if it had been correct, Beck is known to be very unreliable as an authority, which is proved in this instance by the fact that in the hope of finding "one of the largest mounds in this country" as described by him; Mr. O. W. Collett, of the Missouri Historical Society, some time since, thoroughly searched the banks of the Osage River for miles, in the neighborhood designated by Beck, without being able to find the slightest evidence that any such mound ever existed.

Prof. Winchell devotes considerable space to prove that the Indian tribes, at the time of their first contact with white men, made use of copper, a fact which no one has denied, and makes a number of quotations and references, as he says, "in regard to the use of copper and the *mining* of it by American aborigines." I have read the quotations carefully, but without finding a word in any of them respecting mining.

Again at page 614, he says, "Thus at a distance of from 800 to 1,000 miles from its origin, Cartier in 1555, and Champlain in 1610, encountered Indians who informed them of the *manner of mining* and of manufacturing copper implements." Neither Cartier or Champlain, in their narratives say anything about "the manner of mining," on the contrary they say the Indians told them they gathered the copper in lumps.

Col. Whittlesey says,[0] "Detached and water-worn lumps of copper have been found in great numbers in the gravel, clay, and loose materials that cover the rocks, from the days of the Catholic fathers to this time, not only in the mineral regions but over a large space, to the southward of it." Pieces of drift copper have been found in many places in Wisconsin, and one weighing five or six pounds is recorded as having been found in the drift gravel in Medina County, Ohio. It was from such sources that the modern Indian tribes obtained their supplies of copper, there is not a particle of evidence to connect them with the ancient mining operations, or to prove that they had any knowledge or tradition concerning them. Col. Whittlesey states that all the evidences prove that the

0 Ancient Mining on the Shores of Lake Superior, page 1.

ancient mines had been abandoned hundreds of years before the French became acquainted with the northern tribes.

The problems that American archæologists and ethnologists have before them for solution, are so many and so difficult, and the amount of work to be done is so large, before they can unravel the mysteries of pre-historic life on this continent, that it is very unfortunate that the clouds of misapprehension and error should be rendered more dense by careless and incorrect quotations and unsupported statements. In some quarters there is a disposition to over-rate the culture and conditions of social life among the ancient inhabitants of the Mississippi Valley, while in others there is a tendency to err in the opposite direction. Both parties in their desire to maintain their favorite theories are only too apt to ignore many difficulties and to attempt to settle disputed points by baseless assumptions. It is only by preserving a middle course between these extremes and by devoting our energies to arrive at the truth, irrespective of preconceived opinions, that any work can be done that will yield scientific results worth preserving, or that will aid us in giving an intelligent answer to the question "Who were the Mound-Builders?"

THE TABLET OF THE CROSS.

WARREN WATSON.

EDITOR KANSAS CITY REVIEW:

In the August number of the REVIEW Prof. Mason and Mr. Hilder take me to task for presuming to doubt the views of Messrs. Rau and Holden on the Smithsonian Tablet; and, if I permitted their articles to pass without some rejoinder, their courteous strictures would go far to convict me of inexcusable ignorance concerning the subject.

I desire to say, then, that the learned and valuable speculations of Dr. Rau are quite familiar to me; that they render extremely probable the prior views of Matile and Valentini; but that they identify beyond a doubt the Smithsonian Tablet as the right lateral slab of the Cross group I must respectfully deny. The fact is the restoration of the complete Tablet as set forth by Dr. Rau would not be received in court as evidence without further proof of its authenticity. Who procured the Smithsonian fragments? From what portion of the ruins were they taken? Did all the fragments come from the same locality? When were they procured? How and when did they come into the possession of Mr. Russell? These questions seem to be pertinent to the inquiry, yet none of them are answered by Dr. Rau except in a rather perfunctory manner. He finds the Tablet at Washington; he discovers that in 1842 it was consigned to the Patent Office as "the fragments of a Tablet from the ruins of Palenque;" that it bears a striking resemblance to the right portion of the Kingsborough's plate of the complete Tablet and that it fits almost exactly the center stone as pictured by Waldeck,

Stephens and Charnay. These are strong facts, but our information regarding the genuine Tablet is of such a nature that these facts, instead of deciding the question, entangle us all the more hopelessly. Waldeck (1832) intimates that the Tablet was entire when he visited the ruins, but he only depicted the central stone and the right lateral slab; but it was certainly complete at the earlier visit (1831) of Galindo. Stephens (1840) states that "the stone on the right is broken and, unfortunately, altogether destroyed; *most of the fragments have disappeared;*" and he goes on to say that "from the few" fragments found he did not doubt it contained a similar inscription to that on the left. Charney (1858) found the two lateral slabs containing hieroglyphics "*in place in the sanctuary of the temple;*" reiterating this statement twice with a circumstantiality of description that bewilders one who has just read the testimony of Stephens or been told that "by travelling to Washington" he may see one of these identical slabs. It cannot be possible that Stephens, Charnay and Rau are all correct. It might be possible that the missing slab was not so completely destroyed as Stephens thought and that the fragments seen by him in 1840 were gathered up in 1842 and shipped to Washington; but in coming to this conclusion we must ignore his statement that "most of the fragments" had disappeared.

Between Charnay and Rau there is a gulf that no suppositions can cross unless we conceive that some Central American Antiquarian has duplicated Dr. Rau's restoration by the help of other "fragments of a Tablet from the ruins of Palenque."*

RELICS OF A RACE OF MOUND-BUILDERS IN CALIFORNIA.

With the exception of those who have made the subject an especial study, but few people are aware of how thickly the relics and traces of former habitations of a long-forgotten and prehistoric race are scattered all over the Pacific coast. For archæologists the subject is a decidedly interesting one, furnishing as it does an endless field for investigation and speculation. These traces are particularly numerous in the southern portion of our State, and in that section the researches of scientific men have met with an especially rich reward. Numerous parties, under the auspices of various organizations, have at various times gone over portions of the field and made many and important discoveries. But to the careful searcher there is yet a large and unexplored region which will amply repay any labor expended in that direction. On the borders of the Colorado Desert traces of former habitations are to be found in the presence of enormous heaps of broken crockery, and trails worn so deep in the solid rock that thousands of feet continually passing to and fro must have consumed ages before the pathways assumed their present form, and many other indications may be seen going to show that at some remote period that now desert waste must have sustained a vast population.

One locality in particular on the Mojave desert deserves especial mention. In an utterly dry and desolate section, far from any apparent inducements for the settlement of even the wandering desert Indians, are twelve mounds or cairns of loose rock, piled up to an elevation of some five or six feet. The rocks of which these mounds are composed must have been carried for a great distance, as none like them are to be found in that neighborhood, and a vast amount of time and labor must have been consumed in the apparently useless task. What these monuments represent, or what may be concealed beneath them, is entirely a matter of conjecture, and no doubt a thorough prospecting of them would amply repay any curious scientist. Their remoteness of location has, so far, prevented any one from making any thorough examination of these interesting relics of the past. The Indians of that desert claim to have no knowledge of the purpose or origin of these cairns, but say they have always been there, and that their forefathers knew as little about them as they themselves.

The researches so far made into the remains of this prehistoric people have been almost entirely confined to the southern seacoast and the islands off the shore. Of these islands, San Nicolas, Santa Cruz and San Miguel have proved especially rich in relics. Many tons of stone implements, knives, lances, arrowheads, bowls, mortars, etc., have been excavated and sent to museums in various portions of the world. All these islands—Santa Cruz, Santa Rosa, San Miguel, San Nicholas and Anacapa—bear traces of having at some distant day been densely populated, though what manner of men they were and what their history is entirely a matter of conjecture, since, as far as known, no traces of any attempt at carving or writing by means of hieroglyphics have ever been discovered.

At Point Duma, in the extreme south western part of Ventura County, the traces of a large settlement are to be seen. Here the debris from the ancient dwellings has formed a large and deep deposit, covering a great extent of ground. The burial places of the former inhabitants have been discovered, and in many places excavated, and large quantities of the stone implements therein found have been taken away by enthusiastic and professional relic hunters. Coming further up the coast, at Point Rincon, nearly on the boundary line between Ventura and Santa Barbara Counties, are to be found perhaps the most extensive evidences of a former settlement that exist anywhere in this State. Here, for a space of upward of two hundred acres, the entire surface of the ground is covered with a deposit of refuse left by the former inhabitants, varying in depth from two to fifteen feet. This debris is composed of powdered shells, bones of all sorts of animals, mostly in a calcined condition, the remains of former fire-places, and by no means the least, vast quantities of human remains. In the entire section it is almost impossible to dig to any depth without striking human remains in more or less quantity, and all bearing evidence of having been interred for an incalculable period, many of the bones crumbling to pieces on being touched, while others are in a fair state of preservation.

The locality of some of the graves is marked by rocks or whalebones, and some sort of care was evidently taken in the burial of the occupants, in some in-

stances a sort of rude box of large flat stone being made to do duty as a coffin. It is in these more methodical tombs that the richest deposits of stone relics are found. In the majority of cases, however, the dead seem to have been thrown promiscuously into the ground, though in one locality the singular circumstance was observed that the bones of children were invariably accompanied by those of an adult, a fact fruitful of speculation. One interesting fact connected with these remains is the regularity and remarkable state af preservation of the teeth found, and also the somewhat singular circumstance that these teeth are almost invariably worn smooth on their upper surface, thus proving that their possessors must have been compelled to eat much more than the traditional "peck of dirt" in order to have produced such a uniformity of surface. It was at this place that sometime since a farmer plowed up a relic which to all appearances would seem to have been intended as a tombstone, with an inscription upon it. This consisted of a large flat bone of a whale. Portions of the surface had been hollowed out and these excavations filled with asphaltum, with which the coast abounds. In this asphaltum, when soft, the tiniest white shells had been imbedded in various patterns, and with such method as to warrant the supposition that some meaning was sought to be conveyed. Unfortunately the bone was in such a state of decay that it fell to pieces, and no effort was made to save more than one or two of the larger fragments.

Acting on the supposition that this was probably the headstone of some important personage, and that a rich deposit would reward the discoverer of his resting-place, many excavations were made in the locality, but nothing of interest was found, the bones having, in all probability, been shifted a considerable distance from its original locality in the course of ages. Numerous parties have, at different times, made the deposit at Point Rincon the scene of their researches, and in nearly every instance have been well repaid. As a matter of course the age of this deposit can only be conjectured, but every indication points to the belief that the race who inhabited the coast antedate all other inhabitants of this continent. One remarkable fact has been noticed, and that is the entire absence of any metallic objects, or any signs of any having been used, showing these aborigines to have been in ignorance of anything of the sort.

At a point on the coast about thirty miles north of Point Rincon, and near the little village of Goleta, is a place called More's Island. This is an elevated plateau, surrounded by lowlands, and which, at no distant period, was an island. Here it had been long known that there were traces of former inhabitants, but no systematic search was ever made until the Wheeler expedition paid that place a visit a few years since, when, in a short time, they exhumed and forwarded to the Smithsonian Institution no less than ten tons of relics of all kinds.

Crossing the Santa Ynez range at Santa Barbara, a region is reached where no one would expect to find evidences of any former population, as the country is as wild, unproductive and inhospitable as can well be imagined. Yet, in some of the remote cañons of the mountain range, and in places almost impossible of access, extensive burial places and remains have been found and many valuable

relics unearthed. At the San Marcos Hot Springs, at the northern base of the Santa Ynez Mountains, are also extensive remains, and excavations made there have been well rewarded. Continuing on through the northern portion of Santa Barbara County may be found many traces of this long-obliterated race, and many places with good indications may be found which have never, as yet, been subjected to an investigation. Notably is this the case in the Santa Maria Valley, and in some portions of San Luis Obispo County.

One interesting fact concerning the implements found is the extreme hardness of the material used, and the almost utter impossibility of working it with even modern stone-cutting tools. Many large bowls and mortars have been found which have been worked from a solid block by some unknown means to an even thickness all through, and of so perfect a regularity of outline as to excite the wonder and admiration of all. When it is borne in mind that the material of these bowls is of the hardest and flintiest description, the perseverance and skill of the savage artificer, as well as the means used, are a wonder. Quite a profitable business is now and has been for years done by various parties in prospecting the country for these aboriginal relics, as such things find a ready sale at the various museums, as well as with many private collectors of antique objects.

In connection with this subject some mention of the famous "Painted Cave" at Santa Barbara may not be out of place. An old Indian trail across the Santa Ynez Mountains leads up the mountain side from one of the oldest of the settlements of the padres—the Indian orchard. Some bee-hunters, several years since, discovered not far from this trail an aperture in the rocks, which could only be reached by clambering down a rope suspended from the rocky ledge above. However, the cave was reached, and found to be a hollow in the rocks of considerable size, with a sandy floor. But the most remarkable thing was the presence of a variety of inscriptions painted upon the rocky sides of the cavern, and which have given rise to all manner of conjectures as to their meaning and origin. So far, however, no satisfactory clew to their meaning has ever been found.—*San Francisco Chronicle.*

Sir Walter Armstrong, at Craigside, near Newcastle, England, has utilized a brook to run a dynamo-electro machine by means of a turbine water-wheel, and so manages to secure electricity enough to keep thirty-seven Swan lamps in a state of incandescence in his house. In this case the motive power costs nothing, and electric lighting in this way is an exceptional luxury.

Mr. Buttgenbach, of the Lintorf lead mines, near Dusseldorf, has devised a disintegrator which separates zinc blende and pyrites ore with great nicety. By specific gravity this can not be effected, but the difference in the cohesive force of the two minerals enables Mr. Buttgenbach to crush the zinc ore to a fine sand and leave the pyrites in its original volume, so that they can be separated by a sieve.

CHEMISTRY AND PHYSIOLOGY.

ALCOHOL AND ITS EFFECTS.

REV. L. J. TEMPLIN.

The earliest authentic account we have of the use of intoxicating liquors as beverages is in the case of Noah, who, it is said, planted a vineyard and became drunken on the wine made from the fruit thereof. From that time down we have frequent accounts of the use and effects of various kinds of intoxicating liquors among many nations and tribes of people. The most common source of these drinks in ancient times was the grape; but the palm tree, pomegranate, and melon have been extensively employed for this purpose in both ancient and modern times. In recent times the various cereals have come into very general use for this purpose. Various other substances, as fruits, milk, etc., are frequently employed for the manufacture of intoxicating drinks. It is only by a process of fermentation that the intoxicating principle is generated, as none of it is ever found in any living substance. In the process of decomposition of any organic substance containing sugar in the presence of water, it passes through three distinct stages; the alcoholic, the acetic, and the putrefactive. It is the business of the brewer and distiller to check the process when it has reached the first stage, and so manipulate their liquor as to prevent any further fermentation. Intoxicating drinks were in use many centuries before any correct knowledge of the true nature of the intoxicating principle was obtained.

The Arabian alchemists discovered that if wine was kept at the boiling point for a few minutes it lost its intoxicating power. The intoxicating principle, whatever that was, had escaped. But this powerful agent was invisible, hence it was regarded as a spirit—the spirit of wine.

About the middle of the eleventh century Avicena caught this subtle agent and gave it a visible, bodily form. Chemists called it "alcohol." This term comes from two Arabic words, Al the, and Kahol, a fine, impalpable powder. The ladies of the east were accustomed to employ such powders at their toilet. The term "alcohol" seems to have been applied to any powerful, subtle agent, but its modern use is confined to the intoxicating principle or strong drinks—the spirit of wine. The process by which this agent is developed is now quite well understood. If starch be moistened with water in which a little ferment, as yeast, has been dissolved, and subjected to a temperature of one hundred degrees of heat it will be changed to grape sugar. But if the temperature be maintained in the presence of a ferment it will be decomposed and its elements separated into carbonic anhydride and alcohol. The gas speedily escapes into the air and the

alcohol remains dissolved into the water. By distillation this is separated from the principal part of the water, the remainder of which may be removed by certain chemical processes and absolute alcohol obtained. It was once believed that alcohol was the product of distillation, but it is now known that this process only separates the alcohol that has already been generated by fermentation. The alcohol in general use contains from seven to fifteen per cent of water. Pure alcohol is a transparent fluid having a specific gravity of 796, water being 1000. It has a very pungent taste, boils at 170° and has never been frozen. It inflames at 300°, burning with a pale blue flame, emitting no smoke, little light but much heat. This agent is a powerful solvent, readily dissolving most of the resinous gums and vegetable extracts. Chemically, alcohol is composed of three gases in the following proportions :

Carbon	51.88
Hydrogen	13.70
Oxygen	34.42
	100.

The amount of alcohol that is found in the different kinds of intoxicating drinks varies with the different classes and kinds of liquors. The following exhibits the proportion of alcohol and proof spirits found in the different kinds of fermented liquors.

	ALCOHOL.	PROOF SPIRITS.
Port Wine	23 per cent.	46 per cent.
Madeira	22 "	24 "
Sherry	19 "	38 "
Champagne	12½ "	25 "
Cider	7 "	14 "
Porter	4¼ "	8½ "
Ale	6½ "	13 "
Small Beer	1¼ "	2½ "

From this it will be seen that these drinks contain from one fortieth to nearly one-half of proof spirits. The proportion of alcohol found in the various kinds of distilled liquors is—

Brandy	53.39 per cent.
Rum	53.68 "
Gin, common	51.60 "
Gin, Hollands	55.44 "
Scotch Whisky	54.32 "
Irish Whisky	73.70 "
Common Whisky	42.95 "

Of this class of liquors we find from over two-fifths to nearly three-fourths to consist of alcohol. Besides the water mingled with the alcohol there are other

ingredients found, especially in the fermented liquors, as the hops in beer, juniper in ale, acids in wine and cider, etc. It is a common opinion that the effects of these various drinks on the human system are modified by the presence of these foreign substances; but it is quite doubtful whether these extraneous substances in the quantities in which they are used, ever have any marked effect on the system. The various effects resulting from the use of the different kinds of drinks is more likely the result of the different degrees of dilution with water that characterize them, or of the manner in which they are taken. If taken in considerable quantities at once the effect will necessarily be more marked than if the same quantity is taken gradually so that it may be gradually taken up and disposed of by the system. In treating of the effect of alcohol on the human system no distinction will be made as to the kinds of liquors which contain the alcohol used. These effects are produced by two different processes, a chemical and a physiological one. Its most important chemical property is to arrest and prevent decomposition in all organic bodies, whether animal or vegetable. For this reason it is largely used for the purpose of preserving natural history specimens in the cabinets of scientists. In its antiseptic properties it is excelled only by creosote, carbolic acid and arseniate of soda; but it has advantages over all these and is more generally used. When taken into the stomach with food it prevents the decomposition of the food under the action of the gastric juices, and hence it tends to retard digestion and is detrimental to health.

But as digestion must proceed that life may be preserved, this evil power must be disposed of in some way. It is a well established fact that the digestive powers of the stomach have no control over this powerful agent. As it cannot be digested and as the digestion of food cannot proceed in its presence nature pro ceeds at once to banish the unwholesome intruder.

Instead of being digested, alcohol is taken up by absorption by the capillary vessels of the stomach and introduced directly into the blood by which it is carried to all parts of the system. It is evident therefore that alcohol cannot be re garded as food in the ordinary use of the term. But it has been observed that if a portion of alcohol be taken at regular and frequent intervals the weight of the body will be increased. Numerous carefully conducted experiments prove this to be true. This fact has led many eminent physicians to believe that alcohol when taken into the stomach acts as a food. But this phenomenon may be accounted for in more strict accordance with the facts without giving it this interpretation. In order to a full understanding of this point it is necessary that we turn aside a little and inquire into the manner in which food is made beneficial to the system. Every organized being is composed of innumerable minute vesicles termed "cells." These cells are constantly dying and being conveyed from the system while their places are being supplied by others formed from material derived from the food eaten. This process of composition and decomposition, of birth and death, is constantly going on in all parts of the physical system. When a particle of material has served its purpose in the system it loses its power to further serve the purposes of the system, and its further presence is detrimental

to health. The highest state of health is secured only by the prompt removal of this effete matter. Thus it appears that we live only by a constant process of dying. Alcohol in the living system, as everywhere else, antagonizes the natural tendency to decomposition. Hence the dead matter that, under the healthy action of the system, would be speedily excreted from the system, is retained longer than it should be. The result is the weight is increased, but it is by the retention of the old matter that should be cast off and not by the addition of new material obtained from the alcohol. Another argument in favor of the nutritious nature of alcohol is based on the nature of this substance. All forms of food substances may be arranged in two general classes, viz: nitrogenous and carbonaceous. The former of these goes to make up the various tissues of the animal system, and the latter results in the development of animal heat and carbonic anhydride. Now as alcohol contains so large a proportion of carbon it was placed at the head of the list of respiratory food substances.

This theory, advanced by so high an authority as Baron Liebig, and looking so plausible on its face, gained at once general acceptance. But it was not long till Dr. Prout demonstrated by experiment that the amount of carbonic acid exhaled from the lungs was directly diminished by the presence of alcohol. Dr. Davis, of Chicago, next took up the question of the development of animal heat from alcohol, and by carefully conducted experiments he demonstrated the fact that so far from the heat of the system being increased under the influence of alcohol it was actually diminished. After taking nutritious food into the stomach the temperature of the body is increased, but after taking alcohol in any form or mixture the temperature soon begins to fall and continues depressed one to two degrees below normal for two or three hours, the extent and duration of this depression being in exact proportion to the amount taken. The world has long labored under the delusion that both the temperature and strength of the body were increased by the presence of alcohol in the system. Dr. Davis's experiments with a very delicate thermometer proved the first a mistake, and an application of the dynamometer showed the last to be an error. The common error on this subject arises from the state of perverted sensibility resulting from the alcohol that has been imbibed.

The individual will assert with great positiveness that he is warmer or stronger while under its influence than at other times, but an application of the proper tests proves his mistake. But it is this appeal to his sensibilities that has misled the world on this subject for generations. In order to a full understanding of this matter it is necessary to inquire more particularly into the effects of alcohol on the human system.

If an application of alcohol be made to any part of the body and continued for sometime it will be found that the sensibility of that part has been diminished. The nerves with which the poison comes in contact are paralyzed to some extent, thus reducing their sensibility. And this leads us to inquire more fully into the real nature of alcohol. The almost universal opinion is that alcohol is a stimulant

and the exhilaration resulting from its use is offered as a proof of this view. What is a stimulant? There are three classes of medicinal agents that produce different chemical changes in the system and so sustain a different relation to the production and expenditure of vital force. One class operates to produce an increased expenditure of vital force without in any way affecting the supply of that force. These are called stimulants. Of this class cayenne pepper, ammonia and guaiacum will serve as examples. A second class increases both the amount of the vital force and its expenditure; these are termed tonics. Iron, quinine, and the active principle of the barks of poplar, willow and dogwood, and of tea and coffee may be taken as samples of this class. A third class retards the chemical changes of the system and so reduces both the production and expenditure of vital force. Dullness, stupor, impaired sensibility and unconsciousness are the results of this class. It is evident that alcohol belongs to this last group The narcotic or anæsthetic effect of alcohol on the nerves and brain renders the individual less sensible of all outward impressions. This diminished susceptibility renders the patient less sensible of heat and cold, weariness and pain.

It has long been noticed as a paradox of human action that the same person will claim that the same alcoholic drink will warm him when cold, cool him when hot, rest him when weary and sooth him when afflicted. It has long been claimed that when a person becomes weary a portion of alcohol will renew his vigor and remove all sense of weariness. If exposed to heat or cold he feels the effects of these extremes less acutely if he has imbibed a portion of alcoholic liquors. Now this sense of weariness, the pain felt in the presence of heat or cold are but sentinels that nature has kindly placed to warn us of the vital powers by these adverse conditions.

When alcohol is taken under such circumstances it adds nothing to the strength or the resisting power of the system; simply renders it less sensible to the evil that is going on—it bribes the sentinel, so to speak, to give no farther warning while the ruin of the system is wrought. The sense of weariness is taken away but the exhaustion goes on all the same. The sense of cold or heat is removed, but this does not prevent the individual from dying with sunstroke on the one hand or freezing on the other; but these fatal results are only hastened.

"But," it may be asked, "if alcohol is not a stimulant why is a man often excited to great nervous and mental activity while under its influence?"

This follows from the anæsthetic nature of the poison. When taken into the stomach, as stated above, the alcohol is taken up at once and conveyed unchanged to all parts of the system. Its first effects are felt at the extremities of the nervous system. These nerve extremities under the paralyzing effects of this narcotic poison lose their power of action and become inert. The vital force that has been sent out from the great nerve-centre—the brain—to be expended at these extremities, finding the nerve fibers inactive—the wires down—is returned toward the nerve-centre, producing increased activity in that organ, resulting in exhilaration and increased nervous activity there. As the effects of the poison move back along the nerve fibers, approaching nearer and nearer the brain, this

exhilaration increases till in many cases it becomes uncontrollable mental excitement. But after a time if the dose has been sufficiently large, when all the outposts have been taken, the enemy enters the very citadel of the mind and lays its paralyzing touch on the brain itself. This high state of mental excitement is quickly changed to one of stupidity and sottishness. Thus the very symptoms relied on to prove that alcohol is a stimulant, when correctly interpreted, only prove it to be a deadly narcotic. The delusions in regard to the true character of alcohol and its effects upon the system, that has prevailed not only among the common people but also among physicians and physiologists has led to errors in practice that have been fraught with unmeasured woe to our race, and has been a sad commentary on the declaration of the wise man that "Wine is a Mocker." But with the increase of light on this subject may we not hope the evils resulting from the misuse of this powerful narcotic poison will speedily cease to afflict mankind.

HUTCHISON, KANSAS.

THE WILL-O'-THE-WISP.

Not often has "dry" Physical Science to do deal with the phenomena which figure in folk-lore. Such an exceptional case is afforded by the nocturnal occurrence known to the learned as *Ingis fatuus*, and to the unlearned in different countries as Jack-o'-Lantern, Will-o'-the-Wisp, Wild- (or rather World-?) fire, Friar's-Lantern, *Feu Follet*, Heerwisch, &c. The exception deserves the more notice as modern chemistry and physics have by no means succeeded in finding a satisfactory explanation of the facts. Facts they undoubtedly are. The *ignis fatuus*, though by no means common, has still from time to time been observed by competent witnesses, and occasionally by several persons in company. Nor is such evidence disputed: let any man of sober habits and ordinary truthfulness state that he saw a Will o'-the-Wisp at such and such a time and place, and the most skeptical of our orthodox *savants* will listen with calm interest, and, though he may question the narrator closely as to the circumstances of the case, he will by no means proclaim it *à priori* impossible, or throw out any insinuations concerning "dominant ideas."

If we examine and compare the most recent and trustworthy records of this phenomenon, we find it described as a light which appears in calm, mild nights, chiefly in summer or autumn. It is most commonly observed in swampy or marshy places, or where much organic matter is undergoing decomposition. Dr. Phipson[1] describes it as most common in England, "in the peaty districts around Port Carlisle, in Cumberland," on the Continent "in the damp valleys between the pretty little university town of Marburg and that of Cassell, and more certainly still in the graveyards outside the town of Gibraltar." The light in question is generally single, though sometimes two wisps are said to have been seen to-

1 Familiar Letters on the Mysteries of Nature. London: Sampson Low & Co.

gether. It glides or bounds along at a variable speed, sometimes maintaining the same vertical level, but at other times rising, falling, and overleaping hedges, trees, etc., and may often be tracked to a distance of a couple of hundred yards from the spot where it originates, or rather where it is first observed. It is recorded as in many cases moving *toward* a pool or swamp, and there disappearing. The light is said to be sometimes globular, spheroidally elongated, or pear-shaped, about the size of "two fists," and varying in color and brilliance, being sometimes visible even in the light of a full moon.

So much for points authenticated by the accordant testimony of trustworthy observers. Popular tradition adds much more. The spectators are said to have sometimes received sudden blows or shocks. According to an old German story, some village children having irritated a Wisp by crying out—

"Heerwisch ho, ho, ho!
Brennst wie Hafer stroh!"

it pursued them into the house, and stunned every person present by blows with its fiery wings. Folk-lore, indeed, distinctly personifies the Wisp, and ascribes to it the intention to mislead the solitary traveller and entice him into a swamp or pond.[2] This view or superstition is by no means extinct, as will appear from the following extract from "Light" (June 24th, 1882, p. 296). A contributor of that journal, who uses the *nom de plume* "Miror," gives the following account as narrated to him by an old cottager:—

"'When I was a ploughboy, at Purbeck, I was sent to the blacksmith, who lived some distance off, with some harness to be mended. The blacksmith was at chapel; this delayed the work, and it was not till half-past nine in the evening that I could start for home. It was pitch dark, and as I went along a Jack-o'-Lantern came hopping before me. It was not above the size of your two fists. I was quite aware that Jack-o'-Lanterns came to lead you out of your path, so I kept my foot in the rut all along the country road, till *he*, the Jack-o'-Lantern, hopped over a gate where there was a pond close by, and tried to entice me there.'

"At the above very evident testimony of evil intention the boy was overwhelmed with fright, and taking to his heels rushed, he knew not where, till he came to a house. There they took him in, and one of the inmates accompanied him over the fields, and put him on his way home.

"'I had not gone far,' continued the old man, 'before another Jack-o'-Lantern came hopping before me, and tried to entice me to a swamp which lay on one side of my way; but I knew where I was, and went straight for home, half dead with fear. Never again would I go to that blacksmith's of an evening.'

"'If he had not kept his foot in the rut,' broke in the old woman, his wife, 'it might have been all over with him. When a Jack-o'-Lantern gets you in the water, then he sniggers; he laughs, you know. I've heard my father say that scores of times.'

2 We cannot help here remarking that mediæval tradition personified certain phases of the nightmare, as the terms Incubus and Succuba sufficiently testify.

"Thus we see the old woman brought forward the testimony of her father also, with respect to the traditional shady character of the Jack-o'-Lantern, or Will-o'-the-Wisp, or *Ignis fatuus*.

"You call the Jack-o'-Lantern *he*,' I said. 'You talk as if you thought it knew what it was about; and by luring you into danger it had an object in view, and not a good one.' "Just so," said the old man. I said I was inclined to agree with him.

"On the man's assenting to the woman's assertion that 'when a Jack-o'-Lantern gets you into the water, then he laughs,' I pressed the question, 'Do you really mean to say that they are really *heard* to laugh—that they make the noise of laughter?' 'Yes,' was the reply. 'But how,' I rejoined, 'can people know that they laugh when those who are led by them get drowned, and do not live to tell it?' "

It is curious that "Miror" speaks of this his own objection—fatal, as it appears to us—as "rather lame special pleading on my part." It must not be forgotten that the occurrence is said to have taken place at Purbeck. Now in the counties of Dorset and Wilts the tendency to personification is very strong, and the country people speak of many things as "he" which in the Metropolitan District and the Northern Counties are always referred to as "it."

A very full and definite account of the appearance of an *Ignis fatuus* is to be met with in a modern work[3] reviewed in our current issue. Some passages of Mr. White's narrative we quote. The inhabitants of Itapua, a small town in the La Plata States, situate on the River Parana, were during the author's stay alarmed by "a mysterious light that appeared almost every night in the second plaza, situated on the high river banks, but where, nevertheless, the ground was in some parts a temporary swamp, from the rains settled in the hollows. In this plaza were posted the line soldiers' barracks, and to the guard bivouacking round their fire at night it first manifested itself. My friend Lieut. Morcillo, the officer in command, soon got to hear of it, and, scenting trickery, issued notice that he had given his soldiers orders to fire upon it whenever and wherever it became visible. The soldiers, as they became more accustomed to the *Ignis fatuus*, began to style it the "Plazera." Singular to relate, no sooner did the light burst forth than it was heralded throughout the town by a universal chorus of howls from the mangy curs in Itapua. In order to elucidate the mystery Lieut. Morcillo and myself visited the plaza for several nights in succession, accompanied by three or four soldiers with loaded rifles and ourselves armed with revolvers. The military were posted round the square, and we waited from ten o'clock till twelve or one in an atmosphere bathed in the brilliancy of a full moon. Only twice was it seen by me, but then very distinctly; the first time some little distance off, but the second quite close. On the first occasion the light started up from the ground with the brightness and speed of a rocket, and then again descended to the earth with equal velocity but less splendor: on the second we

3 Cameos from the Silver Land, by E. W. White, F. Z. S. London: Van Voorst, Vol. ii., p. 447.

caught sight of it as it directly, but gently, approached along the road, upon which, running to intercept it, and stumbling at every step over rough and swampy ground, we managed to arrive within three yards of the glowing vision as it slowly glided on at a level of about five feet from the earth. It presented a globular form of bluish light, so intense that we could scarcely look at it, but emitted no rays and cast no shadows; and when about actually to grasp the incandescent nothingness, suddenly elongating into a pear-shape tapering to the ground, it instantly vanished; but on looking round up it rose again within fifty yards, but this time we could not overtake it, as it bounded over a hedge, then over trees, and finally disappeared in an impenetrable swamp. According to the testimony of the soldiers, on another occasion, they beheld it rise from the swamp and perch for some minutes on the top of the roof of a neighboring rancho without walls, after which it pierced the roof and subsided in the ground beneath; but in our case there was no deception, and moreover we noticed that it never appeared on a windy night nor after rain." The author adds, in comment, "Although the marsh-gas theory presented itself to my unwilling mind, it would have to be strained considerably to be able to account for all the attendant circumstances."

We will now attempt an examination of the various hypotheses proposed for the explanation of the Wisp.

Trickery may at once be set aside as out of the question. The movement of the light is totally unlike that of a man carrying a lantern. It is at times much swifter, overleaps objects which a man could not surmount, and plays often over water, and at heights of from twenty to fifty feet in the air. Neither can we consider that it is produc ed by the reflection of a light thrown from some neighboring house. Fire-works are equally out of the question. Not to speak of the slowly progressive movements of the Wisp sometimes observed, it is in the highest degree improbable that any trickster would convey a quantity of pyrotechnical appliances into solitary moorlands, woods, and peat-bogs, in order to alarm some stray traveller.

Another hypothesis, advanced by certain very learned authors, such as Ray, Willoughby, Kirby, and Spence,—ascribes the Wisp to luminous insects. Dr. Dereham and Dr. Phipson combat this view on the ground that such insects "rise far higher in the air than does the Wisp, and present the appearance of hundreds of little specks of light." This argument seems scarcely valid; luminous insects are in all probability more numerous than is ordinarily supposed, and vary considerably in their habits. Not all are high flyers, nor are they all gregarious. The apparent size of the light may be considered a fatal obstacle, since no known English insect emits a light of the size of "two fists." But a light seen on a dark night by a superstitious and terrified ploughboy will very naturally be described—and that without any conscious or intentional exaggeration—as much larger than it really was. The circumstances that the Wisp is chiefly seen in calm weather and during the summer season are in favor of this supposition. But we have some positive testimony to advance. The Rev. Dr. Sutton, of Norwich,

informed Dr. Kirby that when he was curate of Ickleton, in Cambridgeshire, in 1780, a farmer of that place, of the name Simpringham, brought him a mole-cricket (*Gryllotalpa vulgaris*), and told him that one of his people, seeing a *Jack-o'-Lantern*, struck at it and knocked it down, when it proved to be the insect in question. Mr. Main ("Mag. of Natural History," n. s., i., p. 549) was told by a farmer that he had encountered and knocked down the luminous object, which he described as being exactly like a "maggy longlegs" (*Tipula oleracea*), an insect, we must add, especially abundant in boggy and marshy lands. Dr. Dereham, the opponent of the insect theory ("Phil. Trans.," 1729, p. 204), describes an *Ignis fatuus* which he had personally witnessed as flitting about a thistle—a very likely action for an insect, though unlikely for a volume of inflammable gas or for an evil spirit. Mr. Sheppard informed Dr. Kirby that when travelling one night from Stamford to Grantham, on the top of a stage-coach, he observed "for more than ten minutes a very large *Ignis fatuus* in the low marshy grounds, which had the same motions as a *Tipula*, flying upward and downward, backward and forward, sometimes as settled, and sometimes as hovering in the air." It is remarked that in this case the wind was very high, so that a vapor would have been carried forward in a straight line, which was not the case. We are well aware that the insect-theory is not free from difficulties. Thus the question at once arises, Why is this phenomenon so rare? It is also to be asked whether the light given off by insects is sufficiently strong to be visible at such distances as the Wisp is said to have been?

The orthodox theory at the present day—that of spontaneously inflammable gases, hydrogen phosphide, marsh-gas, and possibly hydrocarbons given off by decomposing animal or vegetable matter, is open to even more formidable objections. The presence of the spontaneously inflammable variety of hydrogen phosphide has never yet, we believe, been analytically demonstrated among the gaseous matter given off from marshes, pools, and cemeteries.

In Brande's "Dictionary of Science, Literature, and Art," (ii., p. 191), the Wisp is ascribed to "the issue of marsh-gas from the earth. This gas, being ignited either accidentally or intentionally, continues to burn with a flame sufficiently luminous to be well seen at night." The writer admits, at the same time, that no natural production of spontaneously inflammable gas has ever been observed. Dr. Phipson gets over the difficulty of ignition by assuming that the gas given off consists of marsh-gas through which a small proportion of hydrogen phosphide is diffused. But an emission of inflammable gases from the earth or the water, however ignited and however composed, will not account for the phenomena in the majority of cases on record. In proof of this let any one perform the simple experiment of stirring up the mud at the bottom of a dirty ditch or pond, and ignite the marsh-gas given off by means, say, of a piece of taper fixed at the end of a fishing-rod. The gas will burn immediately over the surface of the ditch or swamp, but the flame will not travel away for considerable distances, overleaping hedges, stiles, trees, or buildings, or playing over thistles. Further, it is found that the Wisp is most common in calm, fine weather, when the barom

eter is high. But gases pent up in the soil, in marshes, etc., will be most readily evolved when the barometer is low! Rainy and windy weather is not unfrequently foretokened by the rise of bubbles of gas from the bottom of ponds and marshes. We can readily understand, however, that a light produced by inflammable gas might, if the supply was large and constant, hover over an extensive marsh or graveyard. But in such cases it would not be one and the same portion of luminous matter flitting up and down, but a succession of fresh bubbles, jets, or puffs of gas becoming ignited in turn. This accords ill with the facts as reported by observers; they generally speak of a single continuing light.

Another hypothesis refers the phenomenon to electricity. We always find that the less any person knows about electricity the more easy he finds it to account for any unexplained facts by its agency. Luminous appearances of electric origin are certainly well known, such as the "Castor and Pollux," which appears at the extremities of the masts of ships during stormy weather. Similar lights have been noticed, especially in mountainous regions, attaching themselves to umbrellas, lances, alpenstocks, etc. But these phenomena seem essentially distinct from the true *Ignis fatuus*, which, as we have already said, is characteristic of fine weather, and moves about instead of attaching itself to pointed objects.

In all probability several distinct phenomena have been confounded under the name of *Ignis fatuus*, and further careful observation is required for their respective discrimination. Those persons who live in or visit regions where the Wisp occurs might do good service by noting all the circumstances of each case at the earliest possible opportunity. The nature of the soil, the barometric pressure, temperature, the wind, and in short the entire character of the weather, should be recorded, and an attempt should be made to take the spectrum of the light.

It appears that the mediæval and popular notion of the Wisp—a conscious and evil-disposed being—is again brought forward by persons of education. "Miror," whom we have already quoted, whilst accepting the hydrogen phosphide hypothesis, asks further—"May not, however, Spirits of a low and malicious order, bent on mischief, when they find a natural medium in the dark, under circumstances favorable to their malice, make use of this gas, found in marshy places, to suit their purpose? Or may not an evil Spirit, fond of marshy places, have the power to turn an *Ignis fatuus*, that has its rise from natural causes, into a devious course for an evil purpose?" We reply that there is no satisfactory evidence of purposiveness, good or evil, in the movements of the Wisp.—*London Journal of Science.*

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

PARIS, July 29, 1882.

Laennec observed, "the curability of consumption is not above nature, but art possesses no means as yet to arrive at that end." It is to nature that those afflicted with tubercular consumption, or predisposed to that malady turn for relief by seeking for an air of the greatest purity. Where find that genial atmosphere? The doctors prescribe several health stations, and though differing in respect to situation, agree that the main conditions are purity and uniformity. Indeed the best means to oppose to the terrible malady, consist in a residence on the borders of the sea, in a mild climate, practicing a generous regimen, and taking every precaution against chills and coughs.

At present the assistance of nature is demanded under the form of a residence on high mountains; by this is not necessarily meant excessive altitudes, for immunity against phthisis can be secured at altitudes the most various. Altitude also varies with latitude; for example:—in the Andes, consumptive patients are ordered to stations 3,500 yards above the level of the sea, while at Mexico, invalids are sent to reside at similar heights. Consumption is extremely rare in the Pyrenees; in Switzerland it is never met with above an altitude of 1,100 yards; in the Hartz and the Black Forest, it is next to unknown at a height of 560 yards. Exemption is here due perhaps more to the kind of life led by the natives than to elevation. Altitude cannot alone be the cause, for phthisis is common at Andermatt and Splugen, in Switzerland, while it is unknown at Klosters, which has about the same height.

Again, many consumptive patients find relief in sea voyages; now if the level of the sea and elevated health stations produce the same beneficial effects, it is due to these extremes having a common trait—great purity of the air. There is absent what exists in centres of populations so prejudicial to delicate lungs, for where phthisis is not exempt from bad sanitary influences, there its ravages will be most terrible. A pure atmosphere, dry, and protected as much as possible from winds; a dry soil and a sparse population, these are the conditions sought by the consumptive, and which exist in the Upper Engadine and in the Davos Valley. The latter is the first favorite and resembles much the health resorts in the Andes. Saint Moritz is less in request. Davos, from being a pretty village has become a leading winter residence, has about the same altitude as the Mürren so well known to Interlaken tourists—about 2,000 yards; it owes its reputation to the remarkable tranquillity of its atmosphere. The climate resembles a good

deal that of the Pontresina—in the neighboring valley; but when the mountains become covered with snow, generally in November, new conditions come into play, modifying in a remarkable manner winter. Thus, the sky is cloudless, the sun's rays powerful, though unable to melt the snow; there are no warm currents of air, and the valley being well protected against winds, a uniform calm reigns till spring. It is being superiorly protected against sweeping winds, that gives Davos the advantage over Engadine; there are no glaciers in the vicinity as at Pontresina, and it is warmer than the valley of the Inn. At the end of December at Davos, when the snow ceases to fall, the atmosphere becomes still, cold, dry, and tonic. In the night, when the stars shine so brightly, the temperature falls several degrees below freezing point; during the day the sun's rays are so intense, that patients can remain several hours outside, but must at once return to their apartments the moment the sun commences to set. The only drawback against Davos is its drainage, that the local authorities will find it their interest to remedy. An invalid after wintering in the mountains, cannot at once, when spring arrives, descend into the plains; a residence at an intermediary station will be necessary. It is well to add, that the wintering in the mountains does not suit many cases of well-defined consumption; the remedy is admirable for individuals suffering from some accidental affection of the lungs, but in other respects possessing a good constitution; it is also excellent for persons with hereditary predisposition to phthisis, but with whom the disease has not yet appeared; for those even in the preliminary stages of the malady. But under no circumstance ought patients to be sent to this winter station who labor under the fever, and who are of a nervous and excitable temperament. Davos suits chronic bronchitis in children, nervous asthma, anemia, and nervous fatigue generally. As further proof that altitude has not in itself anything curative, the Russians send their pulmonic patients to the Steppes. Arcachon, near Bordeaux, on the borders of the Bay of Biscay, has a well deserved reputation as a winter health resort. Uniformity of temperature even is not a safeguard, for in Ceylon, which possesses a climate remarkably uniform, consumption largely exists.

At the present moment astronomers are much puzzled at a red spot on the disk of Jupiter, it remains fixed since the three years that it has been observed; the spot is four times longer than the length of the earth, is of a pale brick red, upon a luminous white ground, terminating in a point east and west. Jupiter possesses a very extensive atmosphere, for the spots, very varied, that are perceived on his disk, disappear a long time before arriving at the border where the revolution of the planet carries them. Spectrum analysis also confirm the presence of an atmosphere. The pressure is so great on the surface of Jupiter, as to resemble what our air would be if liquified. Perhaps when the red spot in question goes away, it may reveal a little of the real aspect of Jupiter.

M. Faye maintains that comets' tails consist of matter driven from the substance of the comet itself, like smoke. M. Flammarion replies that such is con-

trary to the observed laws of gravitation. Comets, he thinks, are bodies which become highly electrified on approaching the sun; their substance becomes diffused, producing the phenomenon upon space, and opposite to the sun, of great luminous excitability, so as to extend millions upon millions of leagues but without involving any loss of the comet's substance. The same authority again expounds his views on the habitability of planets. Our planet, remarks M. Flammarion, resembles a cup, too small to contain life, which manifests itself in all imaginable and unimaginable conditions, even developing to its own detriment, as in the case of parasitical life. The soil, water, air, all is full of being, of embryos, germs, and fecundity. Life literally overflows everywhere, transforming its manifestations, following time and place, seeking ever new theatres of action. Why then ought planets not be such theatres? Mars for instance, has many analogies with the earth; it possesses an atmosphere, thick it is true, containing, as ours, watery vapor in suspension; it has polar snows, continents, seas; seasons akin to ours, but double their duration. But the planet Mars appears to have neither great oceans nor great continents; it has rugged coasts, complicated by inland seas, islands, peninsulas, straits, capes, gulfs and canals. It may be inferred too, that comparatively, there is less water on Mars than the earth.

M. Bonley does not deny that cold kills trichines in hams, but some academicians still hesitate as to using such affected meat. As a general remark, meat submitted to cold preservation is not consequently bad, and does not possess the objections incident to raw meat so much prescribed for weakly children. Respecting this latter subject, Dr. Vulpian remarks, it is sanctioned by experience, though incapable of scientific demonstration. Pounded raw meat then, favors digestion and restores strength.

Monsieur Cadet has measured the number of red and white globules in our blood; the average number in the one twenty-sixth of a cubic inch, is 5,200,000; it can reach as high as nearly 7,000,000; the number of white is 8,000 or one for every 650 red globules. In the blood of adults the red globules are regular in form and nearly equal in diameter; rarely are small globules found, as is the case with the blood of new born infants and giants; the blood of the new born is richer in red globules than that of adults. Eating and digestion augment the number of white globules; fasting increases the red, not in the absolute sense, but by inducing a greater concentration of red globules in the liquid of the blood.

The Academy of Sciences has been occupied with the fractional differences existing as to the exact position of the axis of the earth, and the consequent difference in position of the stars as determined by astronomers from different standpoints. Messrs. Faye and Folie consider that these problems are intimately associated with the constitution of the globe. Is the latter a crust, covering a centre of liquid fire; is it a perfectly solid mass; or, has the globe a kernel of solid matter, bathed in a fluid substance, the latter in turn being surrounded by a crust?

M. Callas has examined the properties of the new drug *resorcine*, proclaimed to be a sovereign remedy for rheumatism. It possesses the same properties as phenic and salycilic acids; it is less toxical than the former, and is a stimulant for the central nervous system. As an anti-rheumatic, it presents no special claims.

Madam Dr. Schipiloff attributes cadaverific rigidity to the acidification of the fibre of muscles. This opinion, at one time current, is now abandoned, since alkaline injections, that ought to neutralize acids, do not prevent that rigidity.

MINING AND ENGINEERING.

ENGINEERING: PAST AND PRESENT.

ADDRESS OF ASHBEL WELCH,

President of the American Society of Civil Engineers, at the Annual Convention at Washington, D. C., May 16, 1882.

I do not propose this evening to undertake any general survey of the engineering field. For such a survey, I refer you back to Mr. Chanute's address of two years ago. I shall not attempt to glean after him. But I shall speak of several disconnected subjects of present interest, and give some reminiscences showing the contrasts between the past and the present; and in such reminiscences I shall disinter the buried memories of some of the great engineers of the past.

When we look around on the engineering works recently completed, or now in progress or in contemplation, the first thing that strikes us is their extraordinary magnitude.

Prominent among them is the St. Gothard tunnel, passing for 48,900 feet, or more than nine and a quarter miles, through the base of the great Alpine chain which has hitherto been so formidable a barrier between southern and central Europe, a thousand feet below the vale of Urseren and the villages of Andermatt and Hospenthal, and 6,500 feet, or a mile and a quarter, below the eternal snows that cover the crest of the mountain. The cost was about $12,000,000, or nearly $250 per foot lineal. This tunnel is nearly 9,000 feet, or a mile and two-thirds longer than the Mt. Cenis tunnel, by far the longest previously built.

Such stupendous works have been made practically possible by the compressed air drill, and the high explosives now used. In my active engineering days, rocks were drilled for blasting only by the power of human muscle, either by one or two men churning a hole in the rock with a heavy rod some six feet long, or by one man holding and slowly turning a short drill, and another man driving it into the rock with a sledge hammer. Then came the steam rock drill, then the compressed air drill. The compressed air not only does the work, but

it ventilates, and its sudden expansion cools the tunnel or the mine where it is used.

The first, or one of the first tunnels in this country in which the rock was drilled by compressed air, was Nesquehoning, by Mr. J. Dutton Steele. Since then many have been made by the same means, one of the most memorable of which is the Musconetcong tunnel, a mile long, made under the direction of Mr. Robert H. Sayre. This difficult work gave occasion for the valuable treatise on tunnels by Mr. Drinker, who was in immediate engineering charge of it. The Hoosac tunnel, 24,000 feet long, after a long continued struggle, was completed several years ago, and is now in use.

Among the tunnels now being constructed is one half a mile long under the plateau of West Point, and another 4,000 feet long through the hard trap rock of Bergen Ridge, at Weehawken; both on the line of the road now in construction on the west shore of the Hudson. Nearly all the debris from the latter is raised through shafts.

The project is now under serious consideration of making a tunnel some twenty-one miles long under the Straits of Dover. A few years ago such a project would have received only a laugh of incredulity.

The admiration of the world has not yet abated for the boldest of arched bridges yet built, that over the Mississippi at St. Louis, with its steel arches of 500 feet span, its piers of heavy masonry sunk to solid rock more than a hundred and thirty feet below the high water surface of the river, through shifting sands, and during the most fearful floods.

The Brooklyn bridge, 1,595 feet, or nearly a third of a mile long, over an arm of the sea more crowded with commerce than any other in America, and high enough to allow a line of battle ship to sail under it—is drawing to completion, and will be (though perhaps only for a few years, 'till something more stupendous comes), one of the wonders of the world.

Probably the boldest plan for a bridge ever proposed, is that now in contemplation over the Forth at Edinburgh, but of which it is yet premature to speak.

Many very long spans and important bridges are now in progress in this country, such as the one over the Missouri by Mr. Morrison, but time does not permit even a glance at them.

We are now so familiar with the success of suspension bridges for railroads, that we can hardly realize the almost universal disbelief in that success before they were tried. The late John A. Roebling told me before his bridge was finished, that Robert Stephenson had said to him, "If your bridge succeeds, mine is a magnificent blunder." And yet, unexpectedly to the best engineers in the world, the suspension bridge over the Niagara answers the purpose quite as well as the tubular bridge over the St. Lawrence.

The mention of the St. Lawrence reminds us of the great and interesting improvement of that river now going on under the direction of Mr. Kennedy. The original low water channel between Quebec and Montreal, had, in places, a depth of only eleven feet. Now they are increasing the low water depth to twen-

ty-five feet with a width of 300 feet. The work is done with bucket and chain dredges, exceedingly well adapted to the purpose. Some of the buckets are armed with great steel teeth which excavate the solid rock (geologically, Utica slate, but compact rather than slaty in its structure), detaching and bringing up blocks sometimes containing several cubic feet.

If anything of the kind could astonish us in this fast moving age, it would be the rapidity with which, during the past half dozen years, the construction of elevated railroads in New York, and to some extent elsewhere, has gone on. It is of little use to find their aggregate length, for in a few weeks any such estimate must be corrected. There may now be about thirty-three miles of such roads, all double track. The average cost, including stations and equipment, has been about $800,000 per mile.

One of the cases in which a new contrivance effects a great revolution, is that of the elevator. This has been in use for perhaps a quarter of a century at the Continental Hotel in Philadelphia, and in a few other places, but is now coming into general use, and is revolutionizing the mode of building in our great cities, especially in New York. A block of buildings is not now extended along a street as formerly, but is set up on end, and a highway to the different houses or parts of the block, is not horizontally along the sidewalk, but vertically through the elevator shaft. Sky-room is cheaper than earth-room. It is said that a lot on the corner of Wall and Broad streets was recently sold for over $320 per square foot, or at the rate of $14,000,000 per acre! Equal to the surface covered with silver dollars five deep. These stupendous buildings will give engineers and architects much to look after in the way of foundations.

This reminds us of the Holly plan, in limited use elsewhere for several years, now going into extensive use in the city of New York, of dispensing with private fires for heating, and private boilers for generating steam; and furnishing heat and steam power for a considerable district from one great central set of boilers, piled boiler over boiler, tier on tier, for 120 feet in height. This is one of the operations most characteristic of the present time. Nothing is to be done now by the individual, but everything by some institution, or corporation, or central power, or great firm. Man has ceased to be a unit, and become only an atom of a mass. With the disappearance of the things themselves, the dear old phrases "family fireside," and "domestic hearth," are rapidly disappearing.

Mr. Shinn and the engineer, Mr. Emery, have kindly given me some particulars respecting this transportation of heat and power, but I can only refer to one or two points. The first and most obvious necessity is to prevent the escape of the heat. This is done by enclosing the steam-carrying pipe in a small brick tunnel, with a flat cover on the top; and filling the space around the pipe, from the bottom of the tunnel to the flat covering above, with mineral wool, which is found to be an excellent non-conductor. It is made by blowing a jet of steam into a stream or jet of melted furnace slag. The arch and covering of the tunnel are plastered over with asphaltum, to exclude all moisture. The loss of heat is said to be very small. One of the great difficulties comes from the expansion

and contraction of the pipes, the range being more than an inch in a hundred feet. This is provided for by making the end of each section, of about 80 or 100 feet, terminate in very flexible diaphragms of thin copper, the diaphragms being supported by stiff iron ribs.

Among the great enterprises in contemplation, is the interoceanic canal, or the interoceanic railroad for large ships. This is not the occasion for expressing any opinion on any of the competing projects. I will only say that if the world is determined to have a sea level canal, it makes a great mistake in not getting fuller information about the San Blas route.

Many things that have been done by this generation seemed beforehand far less possible than the successful working of the ship railway proposed by Captain Eads. The difficulties are certainly very great, but we can see how they may be overcome. The real question is, whether taking into account the expense of overcoming those difficulties, the construction and operation of such railway will be more economical in the end than the construction and operation of some one of the proposed canals.

The last year has been one of intense activity, particularly in railroad construction. A year or two ago money was so abundant, and, therefore, interest so low, and so many capitalists, great and small, were tired of letting their money lie idle, that new enterprises of many kinds were started, especially new railroads, and enlargements of capacity of those already in use. As the money market has approached its normal condition, some of the new projects have been dropped.

It is instructive to look back and trace the connection between the progress of railroads and the financial condition of the country.

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The railroads opened in the United States, January 1, 1880, aggregated 86,500 miles in length, being 40 per cent of all the railroad mileage of the world. Last year we had 93,600 miles, and this year we have just about 100,000 miles. But mere length is a very inadequate measure of their magnitude. The terminal mile of some roads has probably cost as much as five hundred miles of some other roads. At one time, and possibly now, the cost per ton taken, on the first two miles of the road from New York to Pittsburg, was more than the cost of carrying that ton over the next two hundred miles. The increase in aggregate magnitude of all the roads may be almost as much in the enlargement without increase in length of the old, as in the extension of the new. We hear in more than one case of thirty miles of additional terminal tracks being laid at one point.

The diminished plethora of money, and the greater caution now apparent, will, it is to be hoped, moderate the increase of the means of production and transportation, so as to prevent another stagnation.

The investment in railroad property in the United States is set down at about $5,000,000,000, perhaps about one-eighth of the value of all the property of the country, real and personal.

When we speak of the extraordinary magnitude of the engineering works of the present day, we do not forget the pyramids, temples, and fortifications of

Egypt and Chaldea. Some of them exceeded in magnitude anything that has been made since. What makes it more strange is, that the force that produced them was almost entirely human muscle, while now the work is done largely by steam directed by human brain. Two contrasts strike us as we look at the ancient and modern: the one was executed by slaves and conscripts, with little or no compensation; the other by free men, glad to work for the compensation offered. The old was for the glorification of the few; the modern for the use of the many.

The stagnation that followed the breakdown of 1873, and the consequent low rates of transportation, compelled the managers of railroads to reduce the cost to a point previously thought unattainable, by increasing the power of the engines and the weight of trains, by more convenient arrangements, by more service of the machinery, by cheaper construction and repairs, by better machinery and organizations of labor, and many improved appliances for handling, and by the stoppage of leaks generally.

American engineers and managers have often shown that *poverty* is the mother of invention. For example, they used cross-ties as a temporary substitute because too poor to buy stone blocks, and so made good roads because they were not rich enough to make bad ones. American engineers are, or at any rate, were trained on short allowance of money. As that is the best engineering which accomplishes the purpose at the least cost in the long run, American engineering ought to be of the best.

It is doubtless the fertility of resource coming from the necessity of effecting much with little means, which has created a demand for American engineers in other parts of the world. A few years ago the Government of British India sent for an American engineer, and the first thing they asked him to do was to report on their railroads from the American point of view. Our lamented past president, W. Milnor Roberts, was employed by the Government of Brazil, as I judge from what happened after he went there, to train their engineers, educated in European schools, in American modes and ideas.

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Though canal engineering is a thing of the past, its history is instructive. In England it commenced 120 years ago, the first engineer being James Brindley, a millwright. He seems to have known little of what had been done before, and his plans were evidently original. When he proposed to build an aqueduct across the Irwell for the Duke of Bridgewater's canal, his critics said they had often heard of castles in the air, but they never heard before where they were to be put. Brindley built several canals, on one of which was a tunnel a mile and a third in length.

He was succeeded in canal making by such men as Telford and Smeaton and Rennie. Though uneducated, he gained the admiration of scientific as well as practical men. When he wished to study a subject thoroughly, he "laid in bed to contrive," as he expressed it. The secret of his success, therefore, evidently

lay in concentration of attention on the subject in hand, and he kept out of the way of anything that could distract his attention.

The era of canal building in England was rather less than seventy years: between 1760 and 1830.

During the last decade of the last century, several efforts were made to connect the detached navigable reaches of some of the rivers in this country, by means of short canals and locks. One of these was undertaken at Richmond under the inspiration of General Washington. Another was at Philadelphia, around the Falls of Schuylkill. But the one of special interest in the history of engineering, was at Little Falls on the Mohawk.

The great thoroughfares between the City of New York and the west and northwest was up the Hudson and through the valley of the Mohawk. The transportation through that valley was partly by three, five, or seven-horse teams over the Genessee Turnpike,[1] and partly by boats on the river. Those boats were like what on the Delaware we used to call Durham boats, which were eight feet wide and sixty feet long, drawing, when loaded, a foot or two, and carrying from ten to twenty tons. They were pushed up stream by two or four men, with setting-poles held on their course by the captain with a long steering-oar.

At Little Falls the descent of river is over forty feet, and, of course, the boats could not pass, but their cargo was carried by the portage of two miles, to other boats above or below. To avoid this canal and locks were built. They were finished in 1794. Jedediah Morse (father of S. F. B. Morse of telegraphic fame) published his great standard *American Gazetteer* a few years later, and in it he quotes the following expression of the public sentiment of the time: "The opening of this navigation is a vast acquisition to the commerce of this State." It was conjectured that these locks (which a man could almost jump across), and similar "great works" west of them, might soon make the little town of Albany the capital of a great empire.

The Mohawk continued to be the principal artery of commerce from New York to the interior, until the opening of the Erie Canal in 1825.

Mr. Weston, "that haughty British engineer," as an old gazetteer calls him, was brought over from England to build the locks at Little Falls and elsewhere. One of his assistants was a land surveyor of Rome, New York, named Benjamin Wright, or Judge Wright, as he was called. When, years afterward, it was decided to build the Erie Canal, Judge Wright, though having only the slender experience he had acquired under Weston, was appointed chief engineer. The skill and good judgment which was shown by this father of American engineering, the few errors into which he and his still more inexperienced assistants fell, the great effects produced by them with the means at their command, and the

1 The migration to the West, (which then meant the Genessee country) was over this turnpike in horse or ox teams; the patriarch of the family and his wife having on their shoulders the same black and white coverlet, and the big brass kettle full of dishes hanging under the hinder axletree of the wagon. Some of their grandchildren now sit in the high places of the Nation.

adaptation of their works to the circumstances of the time, are absolutely wonderful.

One of Judge Wright's principal assistants was Canvass White. His skill early brought him into notice, and he was sent by the State of New York to England to learn what he could, especially about hydraulic cement. Despairing of getting it at any reasonable price, and of making it stand the voyage, then from four to ten weeks, he set himself on his return to finding or making a substitute for European cement.

Led partially by the geological position of the hydraulic limes in England, and partly by what was known of their composition, he explored and tested certain rocks of western New York, and made the first discovery of hydraulic cement in America. The State of New York gave him $10,000 for his discovery. Subsequently he discovered or recognized cement rock in Pennsylvania in the way till then unknown, but now so familiar, by the contact of limestone and slate.

And yet how soon those men, once so widely known, are forgotten. An eminent and excellent engineer, who had paid especial attention to cement, lately told me he never heard of Canvass White.

One of Judge Wright's assistants, but much younger than Canvass White, was John B. Jervis, whose name to-day is one of the most honored on the rolls of this society.

Many of the distinctive characteristics of American engineering originated with those Erie Canal engineers. We practice their methods to-day, though most of their very names are forgotten. As a class, they wrote little. There were then no engineering papers prepared, and no engineering societies to perpetuate them, if they had been prepared. They were not scientific men, but knew by intuition what other men knew by calculation. Judge Wright's counsel was "as if a man had inquired at the oracle of God." What science they had, they knew well how to apply to the best advantage. Few men have ever accomplished so much with so little means.

The mention of cement reminds us of quite a new use of it, lately, under the direction of Mr. Chanute. The Erie road crosses the Genesee River by a high viaduct just above a fall. The bed of the river was wearing away, and would soon destroy the viaduct. An artificial bottom of cement has stopped the wear.

The Erie Canal was opened in 1825. Governor Clinton passed through in a boat on one corner of the deck of which stood a cask of water from Lake Erie, on another corner a cask of water of the Hudson. Gov. Clinton limped from the boat to the public halls, and speeches were made by and to him; and it was a great glorification. The result justified the public expectation. It built up the City of New York, and settled the question of commercial supremacy between that city and Philadelphia.[2]

The success of the Erie Canal soon brought about the construction of many others. They were thought to afford the most economical means of transporta-

2 An old pilot once told me that in his younger days there were three or four ships out of Philadelphia to one out of New York.

tion, and railroads were made, not to carry goods to the final destination, but to a canal or other navigation. After the success of the Liverpool and Manchester Railway in 1830, this opinion was seriously shaken, and in a short time canal construction mostly ceased. Its era in this country was scarcely a quarter of a century, between 1817 and 1835.

Canals to be successful now must be capable of passing vessels of large capacity, must not have too much lockage, and the locks must be worked by steam or water-power; the boats must be moved by steam, either on board, when the vessels are large enough, or, when the vessels are smaller, by locomotive on the bank, or by cable at the bottom, and then the locks must be large enough to hold the fleet taken by one locomotive or cable power; there must be plenty of water, and the canal must connect harbors or navigable waters.

I tried towing by locomotive on the canal bank more than forty years ago. There is, of course, no difficulty in one engine towing several boats, but if the locks are not large enough to pass the whole fleet at once, the delay of all the fleet till each boat is passed separately, counterbalances the economy of steam instead of horse-power. The speed even for light boats cannot be increased to more than five or six miles per hour on account of the wave.

Cable-towing, notwithstanding the reported failure on the Erie Canal, can, with proper boats and apparatus, and with experienced men, be easily performed on the crookedest canal in America, as it is now done in Belgium.

Canal engineering does not avail itself of the engineering resources of the age. Little improvement is made in it: mainly, I suppose, because it is not considered worth improving.

The most remarkable early river improvement in this country was that of the Lehigh. About the year 1817, Josiah White and Erskine Hazard commenced the improvement of this river, and made other preparations to inaugurate the anthracite coal trade. In 1820 they sent to market 365 tons, which was the beginning of the regular anthracite coal trade of America. Now the annual amount will soon reach 30,000,000 of tons.

The descending navigation they made consisted, first, in clearing the channel of rocks and confining the water in the rapids, when low, to that narrow channel by boulder wing dams; second, when the fall was too great for this, in building dams with bear-trap locks; and third, in storing the water in pools, and letting it run only when the coal arks were running.

The bear-traps locks have given the hint for several devices since used, and are well worthy of examination. Near each end of the lock was a pair of gates, each gate reaching across the lock and to the back of the recess on each side, which gates, when not damming back the water, lay flat on the bottom of the lock. The lower gate could be made to revolve through an arc of somewhere about 40 degrees around a horizontal axis coincident with its down-stream edge. The upper gate of the pair, when laid flat, lapped over about half of the width of the lower gate, and revolved through a similar arc around its up-stream edge. When laid flat, the water, of course, ran freely over them. They were raised by

admitting the water to them from the pool above head of the lock, through the side wall, when the pressure of the water pressed them up. They were prevented from going too far by shoulders in the recesses. The gates then came within 10 or 15 degrees of being at right angles to each other, the under side of the upstream gate resting on the upstream edge of the downstream gate. They could be held in any position, so as to hold back the water entirely, or let it run over with more or less volume, as required. The arks containing the coal were commonly shot through over the partly raised gates as over so many dams.

Such locks, copied from those on the Lehigh, are now in use on the Ottawa, at the Canadian capital. Many of us at our last convention were shot through them on rafts.

It is well worth inquiry whether these bear-trap gates would not be the best possible, and possibly the cheapest, for letting the water rapidly out of a reservoir for scouring purposes. A full stream could be set running in a few seconds, and the flow could be regulated with perfect ease, and stopped at any moment.

In many rivers it is desirable to dam the stream back at low water, and let it run freely at high water In Belgium, on the Meuse, they use needle dams for this purpose. Another probably better adjustable dam is in use in France. The bear-trap gates, with proper appliances, on a solid platform at the bottom of a river, would enable a man on shore to raise a dam across that river, or if raised, to lower it to the bottom, in a few minutes.

I have used this contrivance for a fish sluice in a permanent dam, by which the water ran freely through the sluices when necessary, and at other times was retained at full height.

The coal, on the descending navigation of the Lehigh, was sent to market in arks consisting of six boxes, sixteen feet square and twenty inches deep, coupled by hinges, the whole carrying about 100 tons.

* * * * * *

About fifty years ago, Professor Henry made a series of brilliant discoveries in electro magnetism, one of which was, that by means of a current through a wire, a signal could be made and information given (by ringing a bell, for example), a long distance off. Years afterward, Steinheil, Morse, Wheatstone and others, applied Henry's discovery to the actual conveyance of information; Morse's apparatus, as it seems to us Americans, being by far the best. The wonder to us now is, why Henry himself did not apply his discovery, and why others did not sooner do so. The answer is found in a very important phase of human mind. The habit of mind into which the scientist is liable, perhaps likely, to fall, is to look at scientific result as his ultimate end. Such result arrived at, the same habit of mind is to use it only to attain further scientific result. Hence, men of science so rarely are benefited pecuniarily by their own researches. Hence, also, it frequently happens that engineers who have kept at their studies without practice till too late in life, are so often less successful than those of far less science, and, perhaps, less intellect, but who have been early trained to apply to practical use what science they have.

Iron ship-building has had almost its entire growth within the last forty years. In the spring of 1845, I visited a small iron ship-yard, then quite a new thing, at Birkenhead, on the south side of the Mersey. The proprietor, in his green flannel roundabout, showed his modest establishment, and explained some of the processes. That proprietor became afterward well known to the world as Sir John Laird, the great iron ship-builder, and especially to this country as the builder of the *Alabama*. The operations of that enterprising craft came near involving us and our cousins across the water in a very serious conflict. This was averted by the moral courage and enlightened patriotism of Grant and Hamilton Fish on this side, and Gladstone and Clarendon on the other, who, not having the fear of demagogues before their eyes, agreed upon arbitration instead of war. All honor to the statesmen who took this great step in Christian civilization.

They were just beginning to build the first dock wall on the red sandstone bed rock of the Mersey; now they have 159 acres of dock-room enclosed. Then Birkenhead was a small village; now it has more than 100,000 inhabitants. America is not the only country that moves.

Mr. Chanute, in his annual address, two years ago, spoke of the first propeller boat used in America. That propeller fell into my hands; and I towed the first fleet of boats ever towed by a propeller tug on this side of the Atlantic, from Philadelphia to Bordentown, in October, 1839. Now, our harbors are full of them. The first propellers ever built in this country, and, as far as I know, the first iron hulls, were the *Anthracite* and the *Black Diamond*, built on the plans of Captain Ericsson, and employed in carrying coal through the Delaware and Raritan Canal. The first sea-going propeller built in this country was the frigate *Princeton*, built on Captain Ericsson's designs, under the direction of Captain Stockton. It was a full rigged sailing ship, the intention being to use steam only as auxiliary.

It should not be forgotten that John Stevens, almost eighty years ago, built a small propeller boat, with two propellers, or "circular sculls," as he called them, and ran it about the harbor of New York. It is wonderful how near his blades approach the angle which experience has shown to be the best. He used a small locomotive boiler, as it would now be called, such as was reinvented by Booth, a quarter of a century later, at Liverpool.

The rapid progress of the country, and the activity of the age, are more strikingly shown by the records of the Post Office Department, than by the increase of population—from three to fifty millions since the revolution—or than by any other statistics I know of. During several years of the time that Benjamin Franklin was Postmaster-General, he personally kept the whole accounts of the department, and all in one small book, and settled with the postmasters and mail carriers. There were then about, perhaps, twenty or thirty dead letters a year, now there are four millions. It now takes eight clerks constantly employed to open them, and I remember that it takes fifty clerks to take charge of one class of them. Franklin kept one small book, which lasted three years, now there are

150 or 200 books, each half a dozen times as large, filled each year. Then the work was done by Franklin for $600 a year, now by 700 clerks, for, perhaps, a million a year.

Within my memory, some of the sciences with which engineers have specially to do, have grown from infancy into at least adolescence.

For example, geology was a collection of interesting but isolated facts, and unverified theories, now it is a science. It used to be considered terribly heterodox, and a young man who cared to stand well with good people found it safest to say nothing about it. To read geology was next to reading Tom Paine. A learned and excellent divine once confidently informed me that all the supposed plants and animals found in the rocks were merely stones that happened to come out in that shape. Now geology has an important connection with the instruction in theological seminaries.

Business and population depend on geology. A geological map of England enables one to locate its occupations and the denser populations. An outcrop of gneiss, extending southwest from New York, forms the limit of tide in the rivers, and fixes the location of Trenton, Philadelphia, Wilmington, Baltimore, Georgetown, Richmond and other cities to the southwest.

When I studied chemistry at school the components of compound bodies were given in percentages. For example, limestone was 48 per cent., oxygen 12 per cent. carbon and 40 per cent. calcium. Of course, nobody could remember such proportions. Nor did it give the proximate elements of the compound. The atomic theory, as it was called, was known, but chemists were cautious about accepting it. They had not yet learned to distinguish between the *theory* of atoms, and the *fact* of equivalents.

One of the most surprising feats of modern science is seen in the daily predictions we have of the morrow's weather. Time was, and many of us remember back to it, when predictions were made, and by intelligent people, too, from the phases of the moon, from weather breeders, from the weather on certain anniversaries, and the like.

More than a century ago Franklin pointed out the fact that northeast storms begin in the southwest, two or three days earlier at New Orleans than at Philadelphia. Much information was afterward accumulated, and scientific investigations were from time to time made by many able men. About forty years ago Prof. Espy, of Philadelphia, announced his theory, that rain is caused by the rarefaction and consequent upper movement of the mixed air and vapor into a colder region, where the vapor is condensed and falls into rain, and that this rarefaction produced by the heated surface of the earth, or by fire or otherwise, causes the denser air to flow in from every side, so that the wind blows toward the rain. All this has been since verified. But this sanguine philosopher did not get the credit he really deserved, but drew upon himself the ridicule of the world, by claiming for his discovery more than it could accomplish, especially by proposing to raise the Mississippi by setting fire to the woods on the Alleghany Mountains, when the hygrometer showed much moisture, and so getting the up-

ward current required to make it rain, just as it commonly rains after any great fire, or the eruption of a volcano, or a battle.

Espy visited Princeton to confer with Prof. Henry. I was present at the interview. Henry, while he thought Espy's main principle quite correct, got very much out of patience with him for several hasty conclusions from statements which, to Henry's cautious, scientific mind, did not seem at all conclusive.[1] After he was gone, Henry chalked out the plan which he afterward, with the co-operation of Guyot and other able men, so successfully carried into execution, of simultaneous observations all over the country, and a daily chart of highest and lowest pressures, and other things about which my memory is less distinct. As everybody knows now, it is the traveling of these lines from west to east, at an average of about thirty miles an hour, that enables the weather predictions to be made.

Our rapid progress involves the frequent undoing of what has only recently been done in the most costly manner. We have seen expensive buildings erected in the City of New York, and then in two or three years torn down to give way to something greater or different. The Alleghany Portage Railroad, of which my brother, Sylvester Welch, was chief engineer, W. Milnor Roberts being one of his assistants, was considered for some years one of the wonders of the world; the improvements in the locomotive and the increased strength of the rails afterward enabled engines to cross the Alleghany without the inclined planes used on that road, and that splendid work, on which so much thought had been expended, was torn up. It is folly to build for the far future.

This reminds me that in a paper written 1829, read before this society two or three years ago. Mr. Moncure Robinson estimated that the tonnage over the Alleghany Mountains at that point might in time reach 30,000 tons per annum. I suppose that the tonnage now over the mountain, on the Pennsylvania railroad, exceeds six millions.

One of the bold and remarkable works of the day is the submarine sewer at Boston, to carry the sewage under an arm of the harbor and across an island far to the seaward. They have discovered, what unfortunately many others have not, that little is gained by emptying sewage into a harbor or into a small river, and so transferring the nuisance from one point to another, or distributing it all over.

Sanitary engineers have been contending each for his own favorite system of sewering and draining cities. Mr. Hering, in his paper read at the convention at Montreal, impressed upon us that no one system is absolutely good or bad, but either is good when adapted to the circumstances, and bad when it is not. Municipal corporations often think that the remedy for unhealthiness is, of course, sewerage, just as some doctors in old times gave their patients calomel without

1 My attention was drawn to this subject by the conference between Espy and Henry, and while travelling in Ireland, I asked my very bright, and on the subjects within his range, intelligent car driver, which way the storms there came from? Evidently he had never thought on that subject, but, adopting on the instant a meteorological creed, answered quick as thought: "The storms, sir, come from which ever way the Lord Almighty chooses to send them."

regard to what was the matter with them, or what kind of constitutions they had.

One of the startling propositions of the day is to bring the waters of Lake George and the upper Hudson by an open canal to supply the City of New York. When somebody asked Brindley what rivers were made for, he said: "To feed navigable canals." The answer now would be: "To supply great cities with water."

Among the subjects to which the attention of the society is now especially turned are Standard Time and the Preservation of Timber. As we expect reports on these, I shall not further refer to them.

One of the most remarkable of modern implements, one whose powers seem almost miraculous, is the diamond drill, which bores into the hardest quartz conglomerate and even into chilled iron. It seems to be capable of much wider application than it has yet had.

The attachment of a car to a moving wire rope, in the way proposed by Col. Paine, without injury to the rope or risk to the car, will probably revolutionize the mode of traction in very many cases.

Within the last year or two the load on each wheel of a freight car has been increased from 5,000 pounds to 8,000 pounds, an increase of 60 per cent. According to Dr. Dudley's observations on the Pennsylvania Railroad, an increase of 60 per cent. on a wheel made an increase in wear per million of tons of a little over 30 per cent. We may expect that this recent increase will increase the wear at least 30 per cent.; that is, the rails on a heavy traffic road that would have lasted with the old machinery ten years, will now last 7.7 years. But with the heavier weight on a wheel, the residuary part of the rail after it is worn down to the limit of safety, must be much stronger than formerly required, in order to bear the heavier weight. Suppose the diminution of the consumable part of the rail on this account to be 20 per cent. (which would be only 4 or 5 per cent. increase on the whole rail) it reduces the duration to 6.16 years with the same traffic. But as the traffic has increased much more rapidly than was expected, it is now probable that the rails on our heavy traffic roads will not last half as long as they were expected to last three or four years ago. If a rail will last a dozen years where actually used, it would not pay to add more than about 30 per cent. to its cost to make it last two dozen years, but it would pay to add 45 per cent. to its cost to prevent its duration from coming down from a dozen to half a dozen years. Steel rails were made fifteen years ago with twice the endurance of those made now. Under the new circumstances, it is probable that it will before long be economy for roads with the heaviest traffic to pay the railmakers a price that will enable them to make rails as durable as the best ever made.

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The subject of tests for large members of metallic structures is now receiving our earnest attention. If I should speak of its necessity it would only be to repeat what is said in our memorial to Congress. I will only again call attention to one point; that is, that the process of manufacture of a large piece of iron or steel may be so different from that of a small piece, and therefore the quality of the

two be so different, though both may be made from the same stock, that the strength of the larger cannot be inferred, but only guessed at, from the known strength of the smaller. In the larger there is more likely to be permanent opposing strains that destroy a large percentage of its strength. A remarkable instance of opposing strains, caused by treatment in manufacture, was pointed out some time ago by Colonel Paine. He found that wire coiled before it was set could not be even straightened without straining the sides beyond the limits of elasticity, and that such wire had nothing near the strength of that coiled straight. As the strength of a large metallic member of a structure cannot be tested by any machine within the reach of individual means, and as to obtain the best results requires the combined skill of several classes of experts, the aid of Congress is invoked to provide a suitable machine, and to create a board of experts whose varied skill shall plan the best experiments.

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Undoubtedly the progress of the age, which is so largely engineering progress, does on the whole greatly increase the welfare of mankind. By making the forces of nature do the hard work, the labors of the toiling millions are lightened many fold. The laboring man now works with brain and eye more than with muscle, and his business is now to apply some principle of science. This raises him intellectually. He now has time for improvement Comfort and refinement, and even luxury, are brought within his reach. The forces of nature having become obedient to the will of man, they are made to produce for him not only plenty, but conveniences and luxuries formerly undreamt of. By the present facilities the races of men are brought into contact with each other. Those races are being assimilated, and the prejudices and hatreds of the past are fading away. Supreme power among men is more than ever in the hands of the most enlightened, and they are sending civilization and Christianity into the regions most benighted. The light of Heaven is beginning to shine into the Harem and the Zenana. And the time seems to be hastening when there shall universally prevail "peace on earth" and "good will toward man."—*Van Nostrand's Magazine.*

COLORADO MINES.

LEADVILLE SMELTERS.—The production of the Leadville smelters, during the month of July, shows 3,604 tons of base bullion, which, after deducting for dross and the precious metals contained in the same, would leave at least 3,500 tons of lead. Every month so far this year has shown a gain over the corresponding period of last year. During the fore part of the year, one month showed a product of 4,000 tons, the output of the Leadville reduction-works. There is now very little question but that the product for the year will aggregate between 40,000 and 43,000 tons. The shipments of lead during the first six months amounted to 21,898 tons, and up to date to 25,500 tons. There have also been

shipped to Pueblo, Kansas City, and other smelting centers more than 30,000 tons of ore to date, this year. At an average of 10 per cent of lead in these ores we have a grand total production of lead of 28,500 tons. How long this production will be maintained, it is difficult to predict. It shows, however, the important part Colorado, and particularly Leadville and its tributary camps, occupy in the mining world, in the production of lead, at the present time.

LITTLE PITTSBURG.—The official report for the week ended July 31st shows: Ore shipped, 112 tons; settled for, 719 tons; balance shipped and unsettled for, 91 tons. During the month of July, 522 tons of ore were shipped and 719 tons settled for.

MONARCH DISTRICT.

From the Leadville *Herald* we take the following notes on this district: The Madonna smelter is running very successfully, and turning out a car-load of bullion daily. The smelter is using only the ore from the Monarch Company's mines, which produces a moderate grade of bullion, but will increase the grade by mixing in ore from the Monarch and other high-grade mines. It is the intention of General Tuttle, manager of the company, to increase the capacity of the smelter by the addition of two fifty-ton stacks in the fall. The company's mines are looking exceedingly well. The main drift, which has been run to connect with the upper workings, shows ore all the way, and it is estimated that the ore-reserves are sufficient to furnish the smelter with a two years' supply of ore.

The Fairplay, located just above the Madonna smelter, has developed a body of high-grade sulphuret ore, the extent of which has not been defined. The Eclipse has during the past week caught ore in the tunnel which has been run to tap the ore-body about 250 feet below the upper workings, and about fifteen tons of ore have been taken out in driving the tunnel. The main shaft, now at a depth of about 185 feet, also shows good ore in the bottom. The ore-bodies previously developed on the forty-five-foot level are still untouched.

Several new and promising discoveries have been made on Limestone Mountain, to the west of the Madonna group; but as yet their extent is not definitely known. The district generally shows considerable activity, and the indications are, that it will assume a prominent place as a producer.

MOSQUITO DISTRICT.

SUNNY SOUTH.—Ore of remarkable richness has been discovered since the recent reported strike. This property is developed by a tunnel which has been run in on the lead for a distance of 70 feet. At 65 feet, an inch streak of ore was cut, which rapidly widened, and on sinking on it for a depth of six feet, the pay-streak increased to two feet of solid ore. During the sinking, twenty-eight sacks of ore was taken out, which, on being tested at the London mine, the native silver being thrown out, yielded returns of 385 ounces in silver and 20 per cent in lead.

PITKIN COUNTY.

INDEPENDENCE DISTRICT.—This camp is only thirty-five miles from Leadville on the opposite side of the Continental Divide, and at about the same elevation. The discoveries already made and the geological features of the region give promise of similar results. The Farwell Company has stamp mills full of ore and is making some excellent strikes on the Mt. Hope side of the gulch. The Minnehaha Company has made a very rich strike between the Farwell mines and the Hamilton Company's lands. The Hamilton Company is still delayed by conflicting surveys, but as soon as these points are settled and the property actually patented, active operations will be commenced and heavy work done all through the winter.

PUEBLO COUNTY.

COLORADO COAL AND IRON COMPANY.—This Company is now turning out 125 tons of Bessemer steel rails per day on a contract made last year for 30,000 tons, the contract price being $70 per ton for a part and $65 a ton for heavy sections. It is expected that the product will soon be increased to 150 tons per day.

SUMMIT COUNTY.

ROBINSON CONSOLIDATED.—A dispatch dated August 9th says: Work was begun to-day on the Robinson Consolidated mine. Three great pumps are handling the water splendidly.

ARTESIAN WELLS IN COLORADO.

Commissioner Horace Burch, who was appointed by the Agricultural Department, at Washington, to select the sites for two experimental borings for artesian wells in Colorado, made a trip to the prairie land in the eastern portion of the State to-day. He was accompanied by Senator Hill, the originator of the artesian well bill, and several railroad officials. The party went to the plateau divide between the headwaters of the Republican River and the South Platte, 112 miles from the city, on the line of the C., B. &. Q. Railroad. The geologist commissioner of last year reported this section of country as giving the most promising indications of a high-water strata. One well will be sunk about a mile from Akron, in a country heretofore dry and arid. Contracts will be immediately let for 2,500 feet. It is thought that a strong flow will be tapped within 1,000 feet. The second well will probably be located near Kit Carson, on the Kansas Pacific Road. The contracts on both wells will have been completed by snow fall.

It will be remembered that the original $30,000 appropriations for artesian well explorations in Colorado was squandered under LeDuc's management. He started a well near Fort Lyon, and paid a heavy royalty to experiment in sinking with a diamond drill. When a depth of only 800 feet had been reached by the

bore the appropriation was exhausted. It was estimated that the same result could have been had under contract for $1,500. Senator Hill obtained the last appropriation from the agricultural fund, and is confident of discovering the flowing well belt. If successful a vast expanse of country now barren and uninhabitable will be converted into lands for agriculture and stock raising.

MISSOURI COPPER MINES.

We have frequently had occasion to refer to the great mineral resources of this State, which as yet have attracted comparatively little attention abroad. For years Missouri's iron, coal, lead and zinc mines have been worked in a quiet sort of a way, but with great profit. Three mining regions only have been brought prominently into notice since mining first assumed the proportions of an industry, namely, the Rich Hill coal fields, the Joplin lead and zinc mines, and the iron ore beds in central and southeast Missouri. But the growth of mining has been steady, if not rapid, and every new development encourages the hope that Missouri will finally rank head and shoulders above any other State in the Mississippi Valley as a producer of the useful metals. Coal, zinc, lead and iron have been mined on a large scale for years, and copper, in small quantities, in different parts of the State. Now, however, appearances would seem to indicate that the mining of copper, so long neglected, will ultimately assume a magnitude that will place Missouri among the leading copper-producing States of the Union. The richest and most promising copper fields at this time are located in St. Genevieve County, south of St. Louis. In presenting a brief history and description of these mines we are indebted for data to a report of Prof. W. B. Potter, of the firm of Potter & Riggs, engineers, on the principal mine in the county—the Cornwall—and to a paper presented by Mr. Frank Nicholson, M. E., to the American Institute of Mining Engineers.

Copper ore was first noticed in St. Genevieve County in 1863, but it was not until 1868 that explorations were begun, Mr. Harris being the leading spirit. After considerable prospecting on the section where the outcroppings had been noticed the work was abandoned without result. In 1872 Messrs. Harris, Rozier & Co. obtained a lease on the Grass mining property for twenty-five years, paying 10 per cent royalty. In 1876 a Chicago firm, Hitchcock, Wilson & Co., began work on a hill opposite that on which copper was first discovered and after a year's fruitless labor the firm failed. The Chicago company's mine was bought in by O. D. Harris, who now owns the Grass and Chicago mines and operates them under the name of the Cornwall Copper Mines. In 1880 the Cornwall mines erected works for making raw mattes and in 1881 refining works were added. From 1876 to 1879 two other mines were opened in the neighborhood of the Cornwall mines, Swansea Copper Mine and the Herzog Copper Mine. These three mines all belong to the same formation, and a study of one reveals the characteristics of all.

The Cornwall mines are located ten miles from the town of St. Genevieve, and the ore occurs in two nearly horizontal sheet deposits, in what is pronounced by Mr. Nicholson to be the second of the magnesian limestone of the Lower Silurian formation. The principal developments in the Cornwall have been made in the upper deposit, while the lower level is chiefly worked at the Swansea mines. Still, the limited amount of prospecting done makes it possible that there are other levels.

Mr. Potter says: "The upper sheet-deposit seems to follow very nearly the bedding of the limestone, and varies in thickness from a few inches to three or four feet. Though varying greatly in thickness, the ore-sheet is remarkably continuous. Occasionally it is wanting in a very small area; but such barren ground is easily worked around, and may be utilized for pillars in the support of the roof. A layer of sandstone, quite thin and irregular, seems to be in most places the immediate associate of the ore, and this at times is found to be altered to a hard ferruginous quartzite, carrying more or less copper. Layers and nodules of chert occur in the limestone at times, making the ground a little hard; but as a rule the latter rock is easy to mine. It is worked out to the parting at the top of the course, which gives an easy plane to break to. This makes the drifts (varying with the position of the ore-sheet in the course) from three and one-half to six and one-half feet high, the average being about five feet.

"The ore itself consists essentially of the sulphurets, copper pyrites and a small amount of the richer 'purple copper.' These minerals have in the upper deposit been somewhat decomposed by the action of percolating surface waters. There is in this deposit a remarkable absence of iron pyrites, which in the other mines is so common an associate of copper pyrites. This must be regarded as a very favorable circumstance, since iron pyrites degrades copper ore not only in richness but in purity, arsenic, antimony, nickel and cobalt being (one or more of them) always found to some extent in this mineral. The ore is in fact remarkably pure."

Prof. Potter, in discussing the question to what extent these deposits can be relied upon to supply ore in the future, states that, though they are not fissure veins, they are sometimes, like the St. Joe and Desloge deposits, of very great extent, and developments already made on the upper Cornwall deposits present evidence enough to show that "the ore extends over a very wide area, and is safe to hold out with any demand likely to be made upon it for a long time to come."

Concerning the cost of mining and treating the ore and the profits of the business, Prof. Potter presents some instructive figures:

Five tons of dressed ore at furnace	$105 55
Smelting the same and producing refined copper	65 62
Total cost, per ton, refined copper	$171 17

Or per pound of refined copper :	CENTS.
Mining, dressing and transportation	5.28
Smelting and refining	3.28
Total cost per pound, refined copper	8.56
Value of refined copper in St. Louis	16.00
Net profit, per pound, copper.	7.44

The value of refined copper has averaged over 18 cents for the past year or so, but 16 cents has been taken as a satisfactory average in the estimate above.

The ore taken from these mines runs about 20 per cent copper, according to Prof. Potter, and about 18 per cent according to Mr. Nicholson.—*Age of Steel.*

A COAL PROBLEM.

The production of anthracite coal last year reached about 28,500,000 tons. This amount is something above the average, but will, in turn, be surpassed by the output this year. It is estimated that not less than 30,000,000 tons will be mined before next January, and the annual production hereafter, under ordinary circumstances, is not likely to fall below that amount. These figures are more significant than they appear to be at first sight.

It is not too much to say that the exhaustion of the anthracite coal-fields of this country is in sight. There are deposits in Rhode Island and Virginia, and small quantities elsewhere; but by far the largest part of the anthracite beds lies in seven counties of Pennsylvania. Four great fields are recognized, their respective areas being 159, 92, 194 and 38 square miles—total 483. To this limited tract the United States looks for its anthracite coal. How much was there in it when mining began, scarcely sixty years ago? How much has already been consumed? How long will what remains last?

The thickness of the beds ranges from thirty to sixty, or perhaps seventy-five feet. But the coal measures are not consecutive or of equal value. Some of them are so thin as to be at this stage valueless. Faults are numerous. The gigantic crushing powers which nature exerted while the coal was forming squeezed some veins out of existence. Others can be mined only with great difficulty. Taking it for granted that the coal land in all underland with workable seams, and knowing the number of tons per foot thickness per square mile, the original contents of the fields may be calculated. It approximated 9,800,000,000 tons. But it must be remembered, not only that much of this coal is not available, but also that the present methods of mining are very wasteful. Even from the richest mines only a small part of the coal is taken. Much of that left behind can never be secured hereafter, no matter how high the price may become.

A writer in the New York *Sun*, who has investigated the subject with some care, says that the best engineering science assumes that only one-third of the coal in first-class seams—the deepest and most faultless—only one-fourth of that in

second-class seams, can be sent to market. But making the most liberal estimate possible, and taking the product of all the fields, as it has been actually worked out, at 151,000 tons per foot thickness of seams per square mile, the marketable contents of all the Pennsylvania anthracite fields when mining began did not exceed 3,275,000,000 tons. The *Coal Trade Journal* two years ago stated the amount of anthracite marketed to the close of 1878 at 307,000,000 tons. The output of the last three years brings the total close on to 400,000,000 tons, or one-eighth of all the coal originally at hand.

In determining how long the remainder will last, the annual consumption, and the possibility of greater economy of production, must be taken into account. In 1820 there was used 365 tons, or barely one ton a day for the United States. The next year the consumption reached 1,000 tons, in 1822 it amounted to 3,700, and so on. In 1829 100,000 tons was passed, the sales that year reaching 112,000; in 1842, 1,000,000 was for the first time exceeded, and in 1864, 10,000,000 tons. Taking 30,000,000 tons for the annual consumption hereafter—and that amount will doubtless be exceeded—the various fields will hold out as follows, allowing each the present proportionate output: Southern or Schuylkill basin, 204 years; Shamokin, 141 years; Mahanoy, 75 years; Wyoming, 70 years; Lackawanna, 64 years; Lehigh, 23 years. "In less than forty years," says the *Sun* writer, "if coal be produced at the rate of 30,000,000 tons per annum, anthracite will be an article of luxury, and the price it will bring in the markets will exclude the poor people of this country from the use of this best of fuels."

It is hardly too much to say that the waste which characterizes the methods of mining now pursued is outrageous. In England and other European countries every pound of coal is taken from the seam, as surely as gold miners take out every particle of quartz within reach. The Pennsylvania system of "pillar and breast" mining, long ago discarded abroad, takes out a cube of coal, and leaves the next cube to support the rock overhead. In many cases half of the contents of the vein is thus abandoned. Waste in other ways reduces the yield of the seam still further to not over one-third of its contents. When coal grows scarcer mere selfishness, even if no considerations of the public good, will occasion closer work, and thus put off the day of the consumption of Pennsylvania's last pound of anthracite. But while waste of bituminous coal is bad enough, that of anthracite is inexcusable.—*Globe-Democrat.*

Thousands of persons assembled at the termini of the St. Gothard tunnel to witness the inauguration of one of the most splendid and universally beneficial engineering achievements of this century. This tunnel is about nine and a quarter miles long, being about one and two-thirds miles longer than that of Mt. Cenis. It runs in a straight line from the village of Goschnen, on the Swiss side, to the Italian frontier locality of Afrolo, thus placing Lucerne and Milan in communication by rail.

ZOOLOGY.

MIGRATIONS OF BIRDS OF PREY.

WILLIAM HOSEA BALLOU.

The question has been broached in the *American Field* concerning the migrations of hawks in flocks. It would seem to be a mooted point, if the variety of opinions of correspondents are to be taken into consideration. So far as my own investigations extend, the matter has never been broached in books, and therefore offers a wide field for study. The question of the certainty of the migration of hawks in flocks was established in my mind in 1874. I was then a resident of the village of Mexico, New York. The village is situated in Oswego County, 400 feet above, and several miles distant from Lake Ontario. Along the shores of Mexico Bay is a great wooded tract in which are swamps, outlets of streams, and occasionally a wide sand beach, or high bluff. In the winter it is the most prolific resort of the snowy and great horned owls I ever visited. Of the first mentioned species I captured fifteen alive in traps during the winter of 1874–5, and a number of the second mentioned. In the spring time I have spent hours along the shore watching the return of birds. First came the crows in literal thousands, taking in the whole range of the shore-line in their noisy efforts to find a crossing-place. Then the ice broke up; great banks disappeared slowly in the sand, and the huge cakes, acres in size, were drawn into the broad mouth of the St. Lawrence. And then—well, one day I sat by the blue waters watching the sublime in nature, and the return of spring. There was a sudden sound that seemed to come from the clouds. The eye was no match for the distance. The sound was multiplied to many cries, whistles, and noises. Slowly a picturesque scene burst upon the view. Away up, just at the limit of vision, was a great moving maelstrom of winged creatures, wheeling, gyrating, crying, and slowly settling. As they came down I recognized among the assemblage of thousands, many species of hawks. I hid in the brush and waited developments. As soon as they came within range, I made an onslaught with my double-barrel breech-loader, firing rapidly, and with terrible effect. The birds seemed powerless to resist, famished with fatigue and hunger. Many settled on the trees, and others continued their slow flight in both directions along the shore, like their predecessors, the crows, in search of a crossing-place. It was three days before all had gone except those destined to remain and breed. On examination of my bag, I found the sharp-shinned, coopers, sparrow, red-tailed, red-shouldered and broad-winged hawks. They were thin in flesh, and looked very much reduced by long flight. Since that time, I have been the witness every spring of a similar spectacle at some point along the lakes, though never of such magnitude.

The next scene takes us westward along the Freshwater System to Evanston, Illinois, on the shore of Lake Michigan. At that place the shore projects out into the lake for some distance, terminating in Gross Point. Here are heavily wooded groves of oaks and a natural rendezvous for all kinds of birds. Last fall there were heavy fogs. Late in October, I noticed the presence of many hawks in the vicinity. They followed the pigeons there and began accumulating. They were so shy that I only secured a half dozen, among which were a pair of duck hawks. One afternoon the fog cleared away, the sun dried the trees and the earth, and made all nature beautiful. About three o'clock that afternoon, I was attracted by the screams of many hawks. They began wheeling over Gross Point, circling around, and gradually passed upward untill not less than 500 formed in the ring. It was a clear day, and my vision was unobstructed. When they had attained a great elevation, there was a sudden halt, and then began a rapid flight to the southwest, evidently toward the Mississippi by way of some river route.

The above furnishes satisfactory evidence of migration of hawks in flocks, and the method of the same. A number of instances have been furnished by the patrons of the *American Field* substantiating the data presented.

Northern hawks migrate south in the winter and southern species come north in the summer. The Swallow-Tail Kite migrates north—well into this State in chase of grasshoppers. Near Cairo I have watched several of them for hours, descending from their lofty gyrations to chase the insect and after obtaining a full craw return to the clouds as if to digest their booty. The Mississippi Kite also makes summer journeys northward.

The instances above related seem to demand some explanation. I therefore present the following table of migrating birds[1] of prey and quasi migrants, as a basis of discussion:

REAL MIGRANTS.

PIGEON HAWK, *Æsalon columbarius.*
SPARROW HAWK, *Tinnunculus sparverius.*
OFSPREY, *Pandion halliætus carolinensis.*
COOPER HAWK, *Accipiter cooperi.*
SHARP SHINNED HAWK, *Accipiter fuscus.*
RED-TAILED HAWK, *Buteo borealis.*
WESTERN RED-TAIL, *Buteo calurus.*
RED-SHOULDERED HAWK, *Buteo lineatus.*
BROAD-WING HAWK, *Buteo Pennsylvanicus.*

QUASI MIGRANTS.

GREAT GRAY OWL, *Ulula cinerea.*
SNOWY OWL, *Nyctea scandica.*
HAWK OWL, *Surivia funerea.*
AMERICAN GOSHAWK, *Aster atricapillus.*

1 The nomenclature adopted is after Prof. Robert Ridgway in his new catalogue of North American Birds, published by the National Museum at Washington.

DUCK HAWK, *Falco peregrinus nævius.*
CARACARA EAGLE, *Polyborus cheriway.*
WHITE-TAILED KITE, *Elanus glaucus.*
SWALLOW-TAILED KITE, *Elanoides forficatus.*
MISSISSIPPI KITE, *Ictinia subcærulea.*
ROUGH LEGGED BUZZARD, *Archbuteo lagopus sancti-johannis.*
BALD EAGLE, *Hallætus leucocephalus.*
MEXICAN GOSHAWK, *Asturina nitida plagita.*

The first table includes hawks which regularly and annually migrate, never remaining far north save in exceptional cases. The second table comprises irregular or quasi migrants, which journey north in summer from their southern limit, or south in winter from their northern habitat. The first series of birds are compelled to migrate. They live more or less on small birds, reptiles, frogs, etc. The reptiles and frogs hibernate, and the small birds migrate south, compelling the hawks to follow them to obtain a subsistence. It was intimated above that they follow the pigeons in their migrations south. Such, indeed, is the case, and many an unwary bird falls prey to their voracity. The principal rendezvous in the United States of their flocking for migration south, I have reason to believe, is at Point aux Pelee, Canada. This point extends perhaps fifteen miles into Lake Erie. Just a short distance out in the lake is Point aux Pelee Island, extending several miles toward the American shore; next beyond, in the same direction, is Gull Island, then Middle Island, then the large Kelly's Island, and finally a long point running out from the western side of Sandusky Bay. Alongside of this north and south range is another comprising the East Sister, Old Hen and Chickens, and the three Bass Islands. Here, then, is a double range extending across Lake Erie, terminating at Point aux Pelee and forming the most accessible route south for all migrants. As the myriads of small birds congregate at Point aux Pelee to effect a crossing of a great body of water, we find every species of the regular migrating hawks mentioned above, on hand, ready to snatch a helpless booty and slaughter a vast number of victims. At this remarkable location I camped a month with the United States corps of engineers, in the fall of 1876, and spent hours—I may say days—watching with an awe which only a lover of nature can feel, the long line of birds passing on to the States. As well think of counting the sands of the sea as those birds; day and night, through storm and calm, the armies swept on in almost endless train. I pause in the hurry of business at times; and the memory of such a scene carries me, in imagination, back to the lonely, uninhabited and desolate point of sand, miles from civilization, where, in solitude, and alone with the infinite, I saw His creatures pass like swarms of insects, obeying His eternal laws.

It seems pertinent at this time to follow the birds of prey on their southern flight and examine their conduct south. I was enabled to accomplish this essential journey. The Corps of Engineers were ordered south on the Mississippi River. We camped at Cairo and surveyed a great area around, including the

bottom lands of Kentucky and Missouri. Here over one hundred species of small birds wintered. Here, too, were immense robin roosts, the extent of which can only be realized by actual observation. The bottom lands along the Mississippi and Ohio Rivers are green in winter with canes. Among these the robins settle at night, in numbers beyond estimation. The roosts afford a plentiful living for birds of prey which fill the woods day and night with discordant cries and owlish hoots. So far, the migration of regular migrating hawks is accounted for on a food basis.

The regular journeys of these birds may now be considered. The owls mentioned in the list, come down from the north to get their share of the rabbits. The snowy owls live principally in winter on the little grey rabbit. The latter spend their nights in traversing frozen swamps for wild berries which grow there and remain in a frozen state during the cold weather, and for the soft bark of alders. I find that rabbits and hares are more abroad nights than days, and consequently afford an easy victim for the owl. The snowy owl is also fond of fish and greedily devours the carcasses found on the lake shores in winter. This species is shot from the piers in the city of Chicago where it watches for such prey, floating on the surface or cast upon the shore.

The bald eagle is included in this catalogue on account of its following a steady course for prey half the length of the continent. They are especially found following large streams in winter for fish, and I have known one to ride on a single cake of ice on the Mississippi River a full hundred miles, snatching up whatever fishes came in his way. These migrations are wonderful on account of the great distances traversed, and the apparent ease with which the flight is made.

All south-moving migrants of the birds of prey are destroyers of game. They gorge on quails and prairie hens, which huddle together in the extreme cold for mutual warmth. They snatch the unwary duck, exhausted in its weary search for wild rice and mollusks. They fearlessly enter the barnyards, and bear away the poultry, fattening on well provided grain. They know no heights, no distances, no mountains, no obstacles, and everything that hath flesh, powerless for defense, they boldly seize as lawful prey.

All north-moving hawks in summer generally prey upon larger insects, mainly grasshoppers and locusts. They include the kites, of Southern United States, and goshawks. The exception is the caracara eagle, which has a fondness for carrion and fish. For perhaps two weeks in summer the kites may be seen in Southern Illinois in lofty aërial flight, making an occasional descent upon the grasshopper.

The conclusions which may safely be drawn from this article are: That certain hawks mentioned migrate in flocks at great elevations. That such migrations have escaped naturalists heretofore on account of the elevations.

That certain birds of prey mentioned are quasi migrants on account of the irregularity with which they migrate, and their doubtful movements at such times.

That most birds of prey are destructive to game birds, songsters and certain game mammals.

And finally, that all migrations of all migratory birds of prey are conducted on a basis of food supply and not from any insufficiency of feathering or delicacy of structure.—*American Field.*

ASTRONOMY.

METEORIC SHOWER OF AUGUST 10, 1882.

WILLIAM DAWSON.

It is believed by those who make a study of the matter, that about the 10th day of August the earth passes through a body, or stream, of meteoric matter by which an unusual number of meteors are then developed. So I kept watch most of the time from 8:30 to near midnight to see what for a show of meteors would be visible. In the three hours near eighty "falling stars" were seen. Making allowance for intervals used in recording the time, position, magnitude, etc. I have no doubt that one hundred or more were developed in the region observed, which was the southeastern part of the sky, including probably one-eighth of the entire hemisphere. It seems likely that they were as numerous in one part of the sky as another. Then, perhaps, eight hundred meteors—all large enough to be easily seen—made their appearance in the upper, or visible, half of the heavens. Applying this calculation to the other half—below my horizon—we get 1,600 for the probable number of meteors developed in three hours.

It is believed that the earth was about two days in passing through the meteor stream. But the outer parts of it are probably thinner than the central—which I suppose was the part traversed by the earth during the 10th. But we will aim to stay within bounds, and suppose the earth to occupy twenty-four hours—say from noon of 10th to noon of 11th—in traversing the main, or average part of the meteoric body. Then we have eight times the number in three hours, equal to 12,800 for the number of meteors which the earth encounters while going through this body of meteoric matter. It may be observed that in twenty-four hours the earth travels 1,600,000 miles.

Some fifteen or more of the meteors observed on the 10th were as bright as stars of the first magnitude, all having trails of light behind them. A few indeed were much brighter—nearly as bright as Venus; making their sudden appearance and flashy trails almost startling. The direction of their motion was generally south to southwest. One or two, however, moved in the opposite direction, and *soon* after another had gone south. Two or three moved across the other tracks nearly at right angles. The motion of nearly all was quite rapid, and the paths

were short say from 5° to 20° in length. Occasionally a bright one appeared soon after another one, and nearly in the same place. Watch was kept on the 11th till near 11:00 P. M.; but the show was much less interesting than on the night previous. Near twenty meteors were seen, nearly all of inferior brightness, though four or five were bright enough to have dim trails behind them.

So far as yet developed, the current year is the epoch of sun-spot maximum for the current period: and April 17th probably the day on which the greatest number of spots were visible. On that day I counted 175 spots on the Sun. The night previous will be remembered as the time of the great aurora, so elegantly written up, and published in the REVIEW, by Prof. E. L. Larkin, of New Windsor, Ill. On the 16th I counted 160 spots in eight groups; but the air was not so good as the 17th, which doubtless prevented several of the least ones from being seen. I did not make repeated observations through the day—the 16th—and thus missed seeing the phenomena of most interest. But I congratulate friend Larkin, whose energy was crowned with such grand success. In January (this year) I only observed the Sun on five days. The spots were pretty well distributed through the month, and no indication of any great show was seen. The greatest number was fifty-seven in five groups, on the 30th. In viewing the Sun I nearly always use a magnifying power of 100 with reflecting-prism-eyepiece, on 4.6-inch objective by A. Clark & Sons. I generally observe about eight or nine o'clock in the morning.

In the fore part of February, about thirty spots were visible. On the 8th I counted 100; most of them in SW. quadrant. After the middle of the month they waned a good deal, and only seven were seen on the first of March. They increased to about seventy-five on the 19th; then fell off to thirty by the last of the month. April soon developed great solar activity. On the 14th seventy-five spots were counted through very poor air. My record says: "Four spots quite large; many others very prominent." Then came the outburst alluded to above, when one or two spots were easily visible without any telescope. And yet this show—especially in number of spots—is small as compared with the preceding sun-spot maximum, in 1870. For, on August 27th that year, I counted 640 sun-spots with the 100 eye-piece and 950 with a power of 200; and through a rather poor air at that. On April 30th eighteen little spots constituted the show, with pretty good air. Next day a large spot appeared at the east edge. The Sun's rotation made it appear to move across the solar disc and disappear at the west edge in twelve days. May 17th, 150 spots, one of them 10,000 miles in diameter, and visible to the naked eye. Two weeks later only three spots visible. Another fortnight brought on seventy-five—all in one group SW. of centre, except ten. The show held on pretty well till about the 9th day of July, when four *little* spots were all that marred a clear whiteness of the Sun's face. But in six days a number of *new* spots had formed, making a row of four groups across the Sun. Quite a show continued for three weeks. But on the 7th day of August (inst.) only three *little* spots lingered very close to the west edge of the Sun. As they would pass the Sun's margin by the morrow, there was a fair prospect of August

8th being clear of sun-spots. But a small one had on the east edge; and in forty hours two large spots had developed near the center of the solar disc; which indicates unusual solar activity. The Northern, or Polar Light, may always be looked for soon after an outbreak of this kind—although it was much less in extent than some others which have occurred at different times. So, on the night of the 11th an aurora appeared in the north. About this time another good-sized spot had come on at the east edge of the Sun. On the 13th it had grown to large dimensions, but on the 15th, had broken up into five smaller ones.

SPICELAND, IND., August 17th.

BOOK NOTICES.

THE ELEMENTS OF FORESTRY: By Franklin B. Hough, Ph. D.; large 12mo. pp. 381. Robert Clarke & Co., Cincinnati, O., 1882. $2.00.

For a number of years Doctor Hough has occupied the position of Chief of the Forestry Division in the Department of Agriculture, at Washington, and has consequently had excellent opportunities for familiarizing himself with the subject of his book, even if he had not had an especial fitness for the work before his appointment. He has undertaken to give in a plain and concise manner practical information concerning the planting and care of forest trees for ornament or profit, also suggestions regarding the creation and care of woodlands with especial adaptation to the wants and conditions of the United States.

The work is admirably illustrated on all points, and the order of the chapters is natural and logical. Beginning with definitions of technical and scientific terms, he takes up in turn Soils and their preparation; Effects of slope and aspect; Climate and meteorological influences; Reproduction from seed; The various modes of propagation of forest trees; The structure and functions of various parts of growing trees; General views in regard to forestry; Acts of Congress relating to timber rights; European plans of forest management; Ornamental planting; Hedges, screens and shelter belts; Cutting and seasoning of wood; Fuel charcoal and wood gas; Causes and prevention of forest fires; Protection from other injuries; Insect ravages; Processes for increasing the durability of timber and improving its quality, etc., etc., closing with a valuable chapter upon Tree-planting in Kansas and Nebraska.

To this latter subject the author has given particular attention, having spent considerable time in the west a few years since studying the meteorology, climate and soil of those States.

We regard the book as eminently practical and valuable to the people of the prairie regions west of the Mississippi where it should and doubtless will have a wide circulation.

NATIONAL RELIGIONS AND UNIVERSAL RELIGIONS: By A. Kuenen, LL. D., D.D.; 12mo. pp. 365. New York, Chas. Scribner's Sons. For sale by M. H. Dickinson. $1.50.

Works upon religious subjects have become within the past few years very attractive and salable, which is due largely to the discussions between theologians and scientists, causing a popular demand for more light upon this and all kindred topics. Darwinism has extended to all branches of science, including the science of religion, and while not all students regard the religious history of the world as the "expression" of a natural process of development "yet there are many who do so regard it and who are finding evolution everywhere.

Dr. Kuenen is a Professor of Theology at Liden who was requested to deliver the Hibbert Lectures for 1882, at London and Oxford, and whose work has been put into English by Rev. Ph. H. Wicksteed in a manner creditable to himself and satisfactory to the author.

The general tenor of the book is to show that the spread of any form of religion beyond the limits of a single people and over many and diverse nations gives it the character of universality as opposed to a national religion. His class of universal religions comprises Christianity, Buddhism and Islamism, though some writers exclude the last named. In discussing the subject he begins with Islam; concerning the origin of which we are best informed and of which we have the most accurate and complete records He admits that the Koran (or Qorán as he spells it) clearly shows what Islam is, but asserts that Mohammed's development of it is confused and obscure; that Mohammed proclaimed the *one* Allah, thus combating the polytheism of the great majority of the people of his day, but that aside from this Islam was largely the individuality of Mohammed modified by his contact with Judaism; that the prophet of Allah is a reproduction of Israel's great leaders and the Qorán a counterpart of "the book" or finally, that Islam was the "kernel of Judaism transplanted to Arabian soil." As to its universality he asserts that despite the fact that it spread all over Arabia, then over a territory surpassing the Roman Empire in extent and still holds a certain sway over 175,000,000 people, it lacks depth, elasticity, comprehensiveness, it is but a side-branch of Judaism, made by an Arab for Arabians, levelled to their capacity and adulterated by national elements calculated to facilitate their reception of it.

We have thus given a meagre outline of the author's manner of treating this branch of the subject. The remainder of the book is given to a similar consideration of the popular religion of Israel, the priests and prophets of Yahwch; the universalism of the prophets; the establishment of Judaism; Judaism and Christianity; Buddhism with a concluding comparison of the three religions of the world as respects their universalism, the mutability of the Christianity as its commendation and the future of Christianity.

No work of recent date covers so much ground so thoroughly, none manifests more minute and accurate knowledge of the subject and none is presented

in more readable and fascinating style. Dr. Kuenen is especially fortunate in his translator.

ANNUAL REPORT OF THE REGENTS OF THE SMITHSONIAN INSTITUTION FOR 1880: Octavo, pp. 772. Government Printing Office, 1881.

As heretofore, the Report is a careful and detailed account of the operations, expenditures, and condition of the Institution for the year 1880, prepared by the Secretary who is also Chief Director. This occupies one hundred and eighty pages and is followed by an appendix comprising five hundred and sixty pages devoted to a record of scientific progress. The introduction to this is by Prof. Baird; the chapter upon Astronomy by Prof. E. S. Holden; those on Geology and Mineralogy by Prof. G. W. Hawes; Physics and Chemistry by Prof. G. F. Barker; Botany by Prof. W. G. Farlow; Zoölogy by Prof. Theo. Gill; Anthropology by Prof. O. T. Mason. These papers are very complete and valuable, and most of them have been published in pamphlet form and distributed long since.

The remainder of the volume is made up of miscellaneous papers on various subjects. Among them is a very interesting account of the Luray Cavern in Page County, Virginia, fully illustrated.

The paper, print, and general make-up of the volume are better than usual, and if the Reports could by any possibility be published promptly, instead of two years after date, they would be warmly welcomed by the scientific public.

REPORT UPON THE U. S. GEOGRAPHICAL SURVEYS WEST OF THE ONE HUNDREDTH MERIDIAN: By Capt. Geo. M. Wheeler, U. S. A.; quarto, pp. 420. Government Printing Office, 1881.

The volume in hand is the third—supplement—Geology, and is an exceedingly handsome book, well printed and illustrated. The writer is Prof. John J. Stevenson, Ph. D., and the immediate subject of the report is geological examinations in Southern Colorado and Northern New Mexico during the years 1878–9. To this is added an appendix upon the Corboniferous Invertebrate fossils of New Mexico prepared by C. A. White, M. D.

OTHER PUBLICATIONS RECEIVED.

Proceedings of the Ohio Mechanics' Institute, Vol. I, No. 3, July, 1882; quarterly, $1.00 per annum. Report of the Commissioners of the 9th Cincinnati Industrial Exposition. The Change of Life in Health and Disease, P. Blakiston & Son, Philadelphia, Pa.; 75c. Proceedings of the American Association for the Advancement of Science, 30th meeting, August, 1881. The Leading Industries of Kansas City, pp. 192, octavo. The *Peoria Medical Monthly*, Aug. 1882; $1 per

annum. Knight's New American Mechanical Dictionary, Part I, $2. Professional Papers of the Signal Service, viz: No. I, Total Eclipse of the Sun, July, 1878, by Prof. Cleveland Abbe; No. II, Isothermical Lines of the United States, 1871 to 1880, by Lieut. A. W. Greeley; No. III, Chronological List of Auroras from 1870 to 1879, by Lieut. A. W. Greeley, U. S. A.; No. IV, Tornadoes of May 29th and 30th, 1879, by John P. Finley, U. S. A.; No. V, Information Relative to Construction and Maintenance of Time Balls, compiled by Winslow Upton; No. VI, Reduction of Air-Pressure to Sea Level at Elevated Stations West of the Mississippi River, by Henry A. Hazen, A. M. The Palenque Tablet (Smithsonian contribution 331), by Dr. Chas. Rau. Report of the Chief Signal Officer, U. S. A., 1879. The Isthmian Passage *via* the Tehuantepec Route, by L. U. Reavis, with an Introductory Letter by Capt. Silas Bent. Proceedings of a Convention of Agriculturists, January 10 to 18, 1882, at Agricultural Department, Washington, D. C. Proceedings of the Davenport Academy of Natural Sciences, Vol. III, Part 2, 1882. Commercial Report of Consuls of the U. S., No. 19, May, 1882. Bulletin of the Essex Institute, Vol. XIV, Nos. 1, 2, 3, and 4, 5, 6. Articles upon Anthropological subjects contributed to the Smithsonian Reports from 1863 to 1877, by Chas. Rau, M. D.

NOTE.—Several of the above will be fully noticed hereafter.—[ED.

SCIENTIFIC MISCELLANY.

ARTIFICIAL BUTTER.

GEO. LANZENDOERFER.

I noticed in your Saturday's edition an article about artificial butter. Allow me a few lines of explanation as a chemist and one who, in his native country, has had frequent opportunities for an insight into the manufacture of artificial butter. The idea of finding a cheap substitute for butter without reducing its value as an article of food was started by Napoleon III, who intended in the first plan to help the working classes of Paris, for even then the price of butter had advanced two to four francs a pound. He invited Mege-Mouries, a chemist, to make a trial in that direction, who succeeded so well that in 1869 the first artificial butter factory was started at Poissy. The Franco-German war stopped operations for awhile, but in 1872 the Societe Anonyme d' Alimentation was started with a capital of 800,000 francs, to take hold of Mr. Mege-Mouries' discoveries. This concern started factories in Paris and Nancy, the former producing to-day 120,000 pounds of artificial butter daily. Other factories started in Munich, Frankfort-on-the-Main, Dresden, Berlin, Vienna, etc.

The United States have been particularly successful in this branch of industry. The factories here not alone supply the domestic wants, but also govern prices to a great extent of the European, particularly the English markets. Favored by a cheap and excellent raw material the American manufacturers are enabled to produce an article in the way of artificial butter which excels all other in quality, taste, etc. As a general rule, any fat and oil will produce butter; that is, all fats may be, by different manipulations and chemical agencies, so prepared that they will appear like butter in taste and flavor, and be suitable for food.

Naturally, and in the first line, beef tallow, coming from the same animal as butter, will be used. Of the beef tallow, that which is found near the kidneys and lungs is the most desirable, which, after being carefully freed from all fleshy particles (of course, only fresh tallow is used), is washed in clean water until the water drains off perfectly clear. Hereafter the fat is chopped fine and afterward melted and crystallized. This done to separate the stearine from the fat, as otherwise the butter would be too hard. We now have a beautiful, clear oil, which is churned with milk. In the whole process cleanliness is to be strictly observed, for otherwise the butter, when ready, would not keep. The painstaking cleanliness with which this artificial butter has to be prepared, apart from that it contains nothing injurious, recommends it for an article of food. All particles of milk must be carefully removed from the finished butter by washing and kneeding, and to save this labor manufacturers prefer to use milk already freed from caseine. After the butter is ready thus far it is colored with annatto, to which are added certain chemicals to give it the flavor and taste of butter. The fat of an ox of average size will produce forty-five to fifty pounds of butter.

There are many articles of our daily food, such as conserves, mustard, catsup, fruit butter, mince meat, etc., which certainly are not prepared in a cleaner, if in as clean a way. Yet they are in daily use without any scruple. As I remarked above, any oil or fat will produce artificial butter, provided it is free from strong smell and taste. Besides tallow, lard, olive oil, poppyseed oil, etc., may be used, but as these oils are dearer than tallow they have not taken its place, particularly as the operations to make the oils into a consistency of fat is very troublesome and expensive. Some months ago, however, I made trials with cottonseed oil, in which I succeeded very well, so that I hope to see it used extensively very soon in the artificial butter manufacture.

Last year I analyzed several lots of dairy butter which contained so much foreign fats as to convince me that they were artificial butter. I must admit, however, that the taste as well as the odor were excellent, and not to be distinguished from genuine butter; and although it was midsummer and very hot, the butter was compact and firm and well made. The manufacturing, therefore, must have been done very carefully and cleanly.

I hope that the above may assist in dispelling the aversion of our people against an article destined by its cheapness and wholesomeness for a valuable substitute of one of our most needed articles of food.—*Philadelphia Times.*

THE TELEGRAPH AND ELECTRIC LIGHT IN EGYPT.

The mounted portions of the telegraph troop Royal Engineers, consisting of about seven officers, one hundred and eighty-four non-commissioned officers and men, and sixty-five horses, with two field-telegraph equipments complete, and the field-pack of the Royal Engineers, including one officer, thirty-three non-commissioned officers and men, and twenty-six horses, under the command of Major Sir A. Mackworth, marched from Aldershot on Saturday last (August 5th,) *en route* to the Southwest India Docks, London, where they will embark to-morrow (August 13th,) in the steamer *Oxenholme* for conveyance to the east.

The telegraph steamer, *John Pender*, which arrived at Alexandria with a sufficient supply of cable on board for the projected line between Suez, Port Said, and Alexandria, was recently engaged in important work for the Eastern Telegraph Company between Lisbon and Land's End. Immediately on the decision of the Government, and from the urgency of the case, she was ordered to Alexandria.

A portable steam-engine has just come out for working an electric machine.

Izzet Effendi, Director of the Telegraphs, sent a staff of employes on the 3rd inst. to lay and open a cable between Jeddah and Souakim.

The *Superb* used her electric light on the night of the 9th inst. from where she lies, off Count Zizinia's house, but whether it was an advantage or otherwise is an open question. From the distance she had to throw the rays it was impossible for those on board to use the light so as to be of the greatest assistance to our sentries. The officer in charge of the picket said that several times the electric light was thrown on his own men, who thus were themselves exposed to view, and at the same time were unable to penetrate the darkness beyond. This is manifestly turning a valuable appliance into a source of danger, and it shows the inutility and even peril of using the electric light indiscriminately. Arrangements have been completed for throwing the electric light over the enemy's lines from Ramleh.—*Electric Review.*

ARTIFICIAL QUININE.

The progress of organic chemistry has been rapid of late. To artificial indigo and citric acid is now added artificial quinine. The sulphate of this alkaloid is in enormous demand, especially in tropical climates, but its enormous cost, we believe about 16s. an ounce, is a barrier to its extended use. The announcement, therefore, that M. Maumené has discovered a means of effecting its synthesis is one of great importance. The alkaloid ($C_{40}H_{24}N_2O_4$) is said by the author to be obtained in a very pure state by a simple process, in which the newly discovered H_2N is employed. Full details of the operation are promised in a short time.—*Mechanical World.*

Says the Boston *Journal of Chemistry:* "Mr. Poirot, having observed that the immense tracts of worm-wood (sage brush) upon the American plains are free from insects of every description, in experimenting with the plant as a preventive of phylloxera. He finds no difficulty in cultivating the worm-wood, and he proposes to mix the stalks with manure, or simply bury them in the ground in the neighborhood of the vines. His suggestions have been sent to the Phylloxera Committee of the French Academy."

CORROSION OF IRON UNDER STEAM PRESSURE.

An occurrence not uncommon in steam engines, is the destruction of the cast-iron directly exposed to the action of the steam, so that it can be readily cut with a knife, like black lead. This destruction is not confined to cast-iron alone, but to wrought-iron also, for many through bolts, such as follower bolts in pistons, are eaten away to such an extent that it seems as though they had been exposed to the action of acids.

The cause of the troubles noticed, which are not mentioned as any recent discovery, is generally attributed to the lubricating oils, or the tallow used for lubrication. It is asserted that the methods of refining these leaves a residue of free acid that in time acts as above stated, and the remedies urged are the substitution of pure fat, such as suet in a natural state without having been rendered.

As a matter of fact, all true animal fats—solid fats—contain three acids, margaric, stearic and oleic, and these are active, so far as regards their acid constituents at ordinary temperatures. Every engineer is aware that the mere presence of cold tallow, on brass work for instance, turns green, from the deposition of verdigris—which is the "rust of brass"—upon it. This free acid theory is an assumption of our own, for chemists do not recognize the existence of the free acids named, in fats, but assert that they are only liberated in the process of soap-making or saponification of the fats by contact with an alkali. However this may be, it is difficult to account for the destruction of metal surfaces in the manner named, and the prompt action of animal grease upon copper or brass, unless free acid is present, for it presents all the appearance of it.

It would seem, therefore, that the methods of preparing lubricating compounds are not directly at fault, but that under certain conditions, such as heat and moisture, decomposition of the structure may be set up with injurious effect. These conditions are present in the steam engine. At a pressure of seventy-five pounds—not at all uncommon nowadays—the temperature is 308°, which, if not enough to set up destructive distillation completely, may partially effect it or in such degree that the surfaces of iron are attacked.

It has been found that pure suet unrendered causes as much injury as commercially prepared fats, though all irons are not as readily corroded as others; some escape entirely.

Recent practice substitutes mineral oils properly prepared for animal fats, and though it would seem that in them not enough body existed to properly lubricate surfaces under heat and friction, they are found to answer well and stop corrosion. This result is probably assisted by the judicious admixture of a certain proportion of animal fat with the mineral oil. However this may be, it is certain that reliable testimony points to the success of properly prepared mineral oils, for cylinder use, and so far as testimony can go, the fact is established.—*Mechanical Engineer.*

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

Below will be found tabular results of observations:

TEMPERATURE OF THE AIR.	July 20th to July 31st.	Aug. 1st to 10th.	Aug. 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	62.0	61.8	61.6	61.8
Max	83.2	82.4	86.7	84.1
Min. and Max	72.5	71.6	71.9	72.0
Range	21.2	21.1	24.0	22.1
TRI-DAILY OBSERVATIONS.				
7 a. m.	69.0	66.6	68.3	68.0
2 p. m.	80.6	78.9	86.2	81.9
9 p. m.	72.1	69.0	72.0	71.0
Mean	73.5	71.1	74.1	73.0
RELATIVE HUMIDITY.				
7. a. m.	. .	. .	. .	. .
2 p. m.	. .	. .	. .	. .
9 p. m.	. .	.	. .	. .
Mean	. .	. .	. .	. .
PRESSURE AS OBSERVED.				
7 a. m.	29.10	29.04	29.06	29.07
2 p. m.	29.09	29.04	29.03	29 05
9 p. m.	29.05	29.03	29.04	29.04
Mean	29.08	29.04	29.05	29.06
MILES PER HOUR OF WIND.				
7 a. m.	5.7	6.6	6.8	6.4
2 p. m.	9.7	13.6	14.0	12.4
9 p. m.	9.2	8.5	9.8	9.2
Total miles	2490	2211	2202	6903
CLOUDING BY TENTHS.				
7 a. m.	4.8	4.5	1.7	3.7
2 p. m.	3.9	3.8	2.9	3.5
9 p. m.	4.3	2.7	1.2	2.7
RAIN.				
Inches	.98	.54	.0	1.52

MEASUREMENT OF WATER.

To measure water roughly in an open stream, take from four to twelve different points in a straight line across the stream, and measure the depth at each of these points, and adding them all together, divide by the number of measurements taken. This quotient will give you the average depth which should be measured in feet. Multiply this average depth in feet by the width in feet, and this will give you the square feet of cross-section of the stream. Multiply this by the velocity of stream in feet per minute, and you will have the cubic feet per minute of the stream. The velocity of the stream can be found by laying off 100 feet on the bank, and then throwing a board into the stream at the middle, note the time passing over the hundred feet, and dividing the 100 feet by the time and multiplying by sixty gives the velocity in feet per minute at the surface. The velocity at the center is only eighty-three per cent of that at the surface, and so only eighty-three per cent should be calculated. For example, suppose the float passes 100 feet in ten seconds, then divided by ten and multiplied by sixty (seconds in the minute) gives 600 feet per minute, as the velocity and eighty-three per cent of this gives 498 feet per minute, as the velocity of the stream at the center, and the area of the cross-section multiplied by this will give you the number of cubic feet per minute in the stream. This, of course, is only a rough way of calculating, but it is often used, and is a good and simple way to obtain data to select a wheel by.—*Craig Ridgway & Son.*

EDITORIAL NOTES.

PROF. W. J. MCGEE has contributed a valuable paper to be read at the meeting of the American Association for the Advancement of Science. The object of this paper is to show in the language of a writer who gives a digest of it, that, to whatever latitude a polar ice-field may extend, precipitation can take place only along its outer margin, and that the temperature of its central portions must sink too low to sustain appreciable quantities of aqueous vapor. By an ingenious system of calculations, he finds that the accumulation of ice is in proportion to the vapor tension, and that, if the thickness of ice at any latitude is known, that at all other latitudes can be readily computed. For instance, if it be assumed that in latitude 40° the ice be three miles thick, with the temperature 56.5; in latitude 50°, temperature 41.7, it would be 1,733 miles; in latitude 60°, temperature 30.2, 1,103 miles; and so on, until in latitude 90°, temperature 2.3, the thickness of ice would be but .315 of a mile. There can, therefore, be little or no ice at the pole. If it were not for this law, if the law were inversed, that the ice-cap should be thickest at the pole, it might be sufficient to displace seriously the earth's centre of gravity. Ice-streams have motion, as rivers of water have. When the slope of the channel increases, the depth decreases and the motion is more rapid at the surface than at the bottom. The velocity decreases in proportion to depth; that is, the shallower the ice-stream the more rapidly it descends. Ice may be bent to any shape by gradual pres-

sure, as a hot iron bar; but breaks, with a clean fracture, when sudden weight is applied. When, therefore, a plate of iron or a stone is placed on ice, it sinks in, and the ice, by the pressure, rises over and covers it, as if the ice were so much pitch. A volume of ice can thus be pressed forward by the simple weight behind it, though the outer line of the ice-stream may be on a level, and the upper portion be pushed on faster than the bottom, which is kept back somewhat by friction against the earth. The great forces producing glacier motion are gravitation, in the passage down slopes, and heat, which, by varying the size of the ice crystals, makes a greater pressure on those portions which absorb the most heat. The surface receives more heat than its base.

JUDGE E. P. WEST has been making a scientific excursion up the Missouri River, and in a recent communication speaks of an important discovery at Weston, Mo. He says:

"On the 8th day of September, 1875, Dr. Parr opened one of the numerous mounds near Weston, and was rewarded by finding in it a human skeleton buried horizontally at full length, and near the head a vase or vessel of antique pottery of the capacity of about one gallon. The vessel contained within it the bones of a fish and some shell beads. It was broken in several places, but remained around the cast of clay within, and with great patience and skill was reconstructed by Dr. Parr, and it now exhibits its original form and markings as distinctly as if it had never been broken. It is what is known as the basket type of pottery, *i. e.* the marking on the outer surface has the appearance of the vessel having been molded in a basket made of grass or small willow twigs for that purpose; and from this fact it has been inferred that pottery of this type was so fashioned; but, from an examination of numerous specimens of this class, and especially from the vase found by Dr. Parr, I have reason to believe that this style of pottery was not so molded, and that the surface marking is only one mode of ornamentation, traced with great patience upon the vessel. The frontal bone of the individual found by Dr. Parr is of the true type of others I have found in the Missouri bluff mounds and described in former articles. It is a type well and strongly marked, and not to be mistaken by those who have once seen it. But what gives to Dr. Parr's find its chief interest is the fish bones found in the vase." * * "It has been the custom of barbarous and semi-barbarous people to inter with their dead the means of subsistance on their long journey to their supposed future abode in another state of being; and they select for this purpose those articles of food they are habitually accustomed to using. The accustomed food of such a people is that which is most accessible to them. During the lacustrine time fish was more accessible than terrestrial animals, for the former must have been very abundant while the latter was probably very scarce. Time moved on, the lacustrine era ended, conditions changed, and terrestrial animals became more plentiful, and more accessible than fish, and, consequently, became the accustomed food of our modern tribes, as fish had been the principal food of the lake shore dwellers, or mound-builders of the Missouri River bluffs. Our modern tribes would never have thought of burying a fish with their dead, and it is probable that the older lake shore dwellers rarely, if ever, used terrestrial animals for this purpose."

THE American Association for the Advancement of Science held its annual meeting this year in Montreal, Canada. This Association holds the same position to science in this country as the British Congress of Science does in England. The meeting for this year was an important one, and the next number of the REVIEW will contain a full digest of the proceedings and papers.

THE Germans will send out four parties to observe the transit of Venus over the Sun's disc, December 6, 1882. This transit will be visible in a greater or less degree to a large part of the world, except to Eastern Europe, and to Asia, and wholly visible to

the eastern portion of North America and to South America. The observers sent out by the German Government will be stationed at Hartford, Conn.; Aiken, S. C.; Bahia Blanca, in the Argentine Republic, and Punta Arenas, on the Straits of Magellan. They will not use photography, but will observe the contacts, while their main dependence will be upon heliometer measures of the place of the planet upon the Sun's disc during the transit. The heliometers used are the same employed in 1874, having an aperture of about three inches.

ITEMS FROM PERIODICALS.

THE *North American Review* for September has the following table of contents: Political Assessments, Oaths in Legal Proceedings, Tornadoes and Their Causes, Architecture in America, Constitutional Protection of Property Rights, Earth-Burial and Cremation, and The Geneva Award and the Ship-Owners. The articles for this number are thoughtful, and some of them possess unusual merit. The article on Political Assessments will be widely read and do good, as it brings to light the nefarious workings of this drag-net thrown out from Washington. The paper on Tornadoes and Their Causes contains some valuable matter, but fails to give the causes as fully as the reader would like. Sergeant John P. Finley, who has done more than any other living author in investigating these fearful meteors, is not even alluded to in the article. This REVIEW holds on its even way through the years always occupying a high plane of thought.

Harper's Magazine for September contains the following articles: A Summer at York, The Weibertrene, The Visit of the Vikings, In Surrey, Spanish Vistas, Love Will Find Out the Way, Some Recollections of Ralph Waldo Emerson, A Doctor Spoiled, Marit and I, The Mississippi River Problem, A Garden Secret, Shandon Bells, with the usual departments and other matter. The number is good as usual, and the articles on Emerson and the Mississippi River are noteworthy.

THE *Atlantic Monthly* for September has the following articles: Two on a Tower, Darkness, American History on the Stage, Evil in Greek Mythology, Doctor Zay, A Geological Ramble on the Weald, Studies in the South, Tears of Isis, The Nation of the Willows, The House of a Merchant Prince, The Last Chance of the Confederacy, William Rufus, Mozley's Reminiscences, Lecky's England in the Eighteenth Century, Leland on the Gypsies, Political Science, Mrs. Kemble's Memoirs and the Contributor's Club, with Book Notices. The *Atlantic* has lost something of its ancient prestige, on account of enterprising rivals. The present number is quite full, and the table of contents is very good. The article entitled "Studies in the South" gives some valuable information of the present condition of that portion of the country. The articles, "American History on the Stage" and "A Geological Ramble on the Weald," are interesting.

THE *Century Magazine* for August has a full table of contents which is exceedingly rich and varied. This magazine lies on a high plane of thought, and is very stimulating to all who are engaged in intellectual pursuits. The articles are generally written by experts in their several departments, and form valuable contributions to the subject. The illustrations are in the best style of art, and are generally well selected. The number for August is called the Mid-Summer Holiday Number and will be a treat enjoyed by all who love good things, in the way of literature and art.

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The Making of England, by John Richard Green; 8vo $2 50

Mackenzie's The 19th Century . . . 1 50

Mackenzie's History of America . . . 1 50

Rawlinson's History of Ancient Egypt. The American Edition with all the original illustrations with translations of the Hieroglyphics and picture-writing of the ancient Egyptians. The most entertaining work of the past decade; 2 vols. octavo, only 6 00

Brugsch's Egypt under the Pharaohs; 2 vols. 8vo, second edition, revised . 12 00

Events and Epochs in Religious History by Jas. Freeman Clarke, 8vo 3 00

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Through Siberia, by Henry Landsell. 2 vols. 8vo., illustrated 8 00

Morocco, Its People and Places, De-Amicis 2 00

Atlantis, The Antediluvian World, by Ignatius Donnelly, 12mo 2 00

Gospel of the Stars, or Primeval Astronomy, a new work by Seiss . . . 1 50

Rude Stone Monuments of all Countries, by James Ferguson, 8vo. cloth, scarce 9 00

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To the Central African Lakes and Back, by Joseph Thompson; 2vols. 12mo . 6 00

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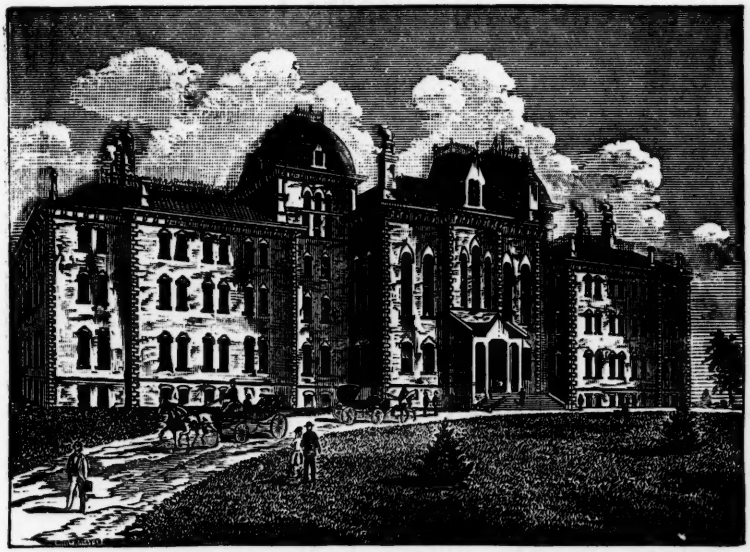

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